

September 28, 1959

Aviation Week

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AVIATION CALENDAR

- Oct. 4-11 Air Age Fair, Bradley Field, Windsor Locks, Conn. Exhibits and fly-in demonstrations.
- Oct. 10-South Anglo American Airlines City Conference, Incubator of the Air, National Bureau, Hotel Astor, New York.
- Oct. 17-18th National Communications Symposium, Hotel Utopia, New York.
- Oct. 18-Sponsor Institute of Radio Engineers' Professional Group on Communications.
- Oct. 18-21st General Conference, National Council Assn. of the United States, Hilton Hotel, San Antonio, Tex.
- Oct. 19-National Automatic Meeting, Society of Automatic Engineers, the Automobile, Los Angeles, Calif.
- Oct. 24-25th Annual Airport Development & Operations Conference, Hotel Chancery, New York, N.Y. Sponsor Bureau of Aeronautics, New York State Department of Commerce.
- Oct. 24-25th Annual Meeting, National Bureau Aircraft Assn., Hotel Lempire, Los Angeles, Calif.
- Oct. 24-25th International Reduction and Efficiency Conference, National Bureau of Aeronautics, Chicago, Ill. Co-sponsored by American Research Foundation in cooperation with Institute of Radio Engineers' Professional Group on Radio Frequency Interference (Class 3) session on Oct. 25.
- Oct. 24-25th National Airport Conference, Norman Dale Spencer, American Assn. of Airport Executives and the University of Oklahoma in cooperation with FAA.
- Oct. 24-25th Indiana Military Qualifier Control Management Symposium, Oklahoma City Air National Arm, Tinker AFB, Okla.
- Oct. 24-25th International Symposium on High Temperature Technology, Aerospace Conference, General Motors, Motor City, Mich. Sponsors: Standard Research Institute.
- Oct. 25-Full Meeting, Underwater, Detroit (Continued on page 6)

AVIATION WEEK Includes Space Technology

October 26, 1959
Vol. 17, No. 18

This week's aviation week is scheduled from October 26 to November 1, 1959. The week's theme is "Space Technology." The week's program is designed to provide a comprehensive survey of the latest developments in space technology, including the design, development, and operation of space vehicles, the use of space for communication, and the use of space for scientific research.

The week's program is divided into two main sections: "Space Technology" and "Space Exploration." The "Space Technology" section includes a series of lectures on the design and development of space vehicles, the use of space for communication, and the use of space for scientific research. The "Space Exploration" section includes a series of lectures on the design and development of space vehicles, the use of space for communication, and the use of space for scientific research.

The week's program is designed to provide a comprehensive survey of the latest developments in space technology, including the design, development, and operation of space vehicles, the use of space for communication, and the use of space for scientific research.

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AVIATION CALENDAR

(Continued from page 5)

- 1958 Division of Aeronautics, Washington, D. C.
- Oct. 24—General Advanced Propulsion Systems Symposium, New England National Ball, Boston Navy Station, Air Force Office of Scientific Research, Aero-Electric Research Laboratory.
- Oct. 24—50th National Symposium on Vacuum Technology, Associated Vacuum Society, Sheraton Hotel, Philadelphia, Pa.
- Oct. 24—Advanced Research and Development Conference, American Management Assn., Johnson Hotel, New York.
- Oct. 27-28—Fourth Annual National Meeting for Traffic Control Assn., 400 West Hotel Columbus City, Ohio.
- Oct. 27-28—Semiannual Convention, American Society of Tool Engineers, St. Louis.
- Oct. 8-10—Society of Experimental Test Pilot's Symposium on Pilot's Role in Space Exploration, Sheraton Hotel, Beverly Hills, Calif. (Host: Aeronautics Society, Oct. 10).
- Oct. 31-15—Third Pacific Area National Meeting, American Society for Testing Materials, Sheraton Hotel, Honolulu, San Francisco, Calif.
- Oct. 12-16-19th Annual Meeting, American Institute of Electrical Engineers, Hotel Victoria, Chicago, Ill.
- Oct. 12-14-14th Annual National Commission and Logistics Finance National Defense Transportation Assn., Olympia Hotel, Seattle, Wash.
- Oct. 12-14—Annual Meeting, National Association of State Aeronautics Officers, West Hyattsville Hotel, San Francisco, Calif.
- Oct. 12-14-15th National Electronics Conference, Hotel Sheraton, Chicago, Ill.
- Oct. 13-16-17th Annual General Meeting of I.A.F.A., (International Federation of Aeronautics), Hotel, Tokyo, Japan.
- Oct. 12-16—NASA's 1958 Inspection Gang in Research Center, Hampton, Va.
- Oct. 13-15—Southwest Airlines Air Safety Forum, Hotel Sheraton, Chicago, Ill. Sponsor: Air Line Pilots Assn.
- Oct. 14-15-1958 Science and Industry Conference and Exhibit, Convention City, Dallas, Texas. San Diego Calif. Sponsor: San Diego County Industries Assn. in cooperation with the Small Business Administration and Department of Defense.
- Oct. 14-21—William Tell II, Scotch World Wide Schnapper, Niagara Falls, N.Y. 1958 Pioneer Gun, Ft. Belk, Va. Defense Command.
- Oct. 14-20-19th Annual Convention, Yachting Assn., Hotel Research, New York.
- Oct. 19-21-17th National Safety Council, National Safety Council, Council Hill, St. Louis, Chicago, Ill.
- Oct. 19-21—Annual Meeting, Aircraft Owners and Pilots Assn., Gilt Ocean Mile Hotel, Fort Lauderdale, Fla.
- Oct. 18-21—Conference on Hypersonic Propulsion Techniques, University of Denver, Denver, Colo.
- Oct. 20-21—Third National Conference on Standards, American Standards Assn., Sheraton-Cadillac Hotel, Detroit, Mich.
- Oct. 22-23-19th Annual Meeting Society for Experimental Stress Analysis, Pick Post Skille Hotel, Detroit, Mich.

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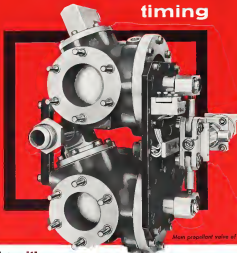


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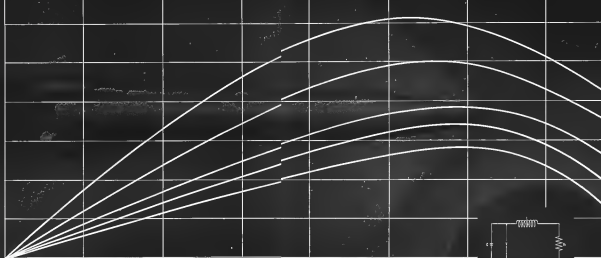
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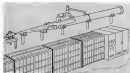
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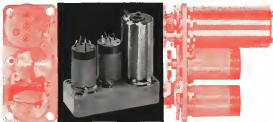
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William Fisher, vice president and general manager, Pacific Division, Teledyne, Inc., Springfield, Mass.

John W. Chalmers and **Robert A. Goss**, vice presidents, Space Recovery Systems, Inc., El Segundo, Calif.

Barry J. Miller, executive vice president and general manager, Lockheed-Vorles Corp., Los Angeles, Calif.

George Thompson, vice president manufacturing operations, Servotronics, Inc., Alexandria, Va.

J. D. Demuth, executive vice president, Nuclear Electronics Corp., Philadelphia, Pa.

William E. H. Kroschke, vice president and sales manager, and **James H. Fenton**, vice president and personnel director, Electro-Synthetic Co., Stamford, Conn.

Joseph J. Smith, chief engineer, George C. Zimmerman, director of manufacturing.

Joseph C. Smith, vice president and director of sales, U. S. Instruments and Systems, Inc., a division of Telegon Industries.

Paul H. Hammond, vice president and general manager, Radio-Columbus, Inc., Anaheim, Calif., subsidiary of Columbia Engineering Company, Inc.

Walter C. Rowland, administrative vice president, The Garrett Corp., Los Angeles.

Dr. Fred J. Lamm, vice president and chief, Minneapolis Honeywell Regulator Co., Minneapolis, Minn.

Edward W. Herold, vice president and chief, Vortex Systems, Palo Alto, Calif.

Marvin L. Stevens, vice president-engineering, Precision Cast and Products, Inc., Patuxent, N. J.

Vern Brown, director of the newly formed Los Angeles Sound Alignment Consulting Company, International Airport, Los Angeles, Calif. Mr. Brown is in active of research in motion picture of the Los Angeles Examiner.

A. N. Chalmers has been appointed General Director of General Industries, Research and Development (Technical).

Jack A. Gerts, chief of the Federal Aviation Agency's Office of Public Affairs, Washington, D. C.

William E. Watson, vice president flight, American Airlines, Inc., and **Walter W. Bessell**, assistant vice president.

Honors and Elections

Dr. Robert T. Wilkins, director of plans and programs for Bell Aircraft Corp.'s Niagara Frontier Division, has spent the Department of Defense's Advanced Research Projects Agency in work on special space projects. Dr. Wilkins is a one-year term of honor from Bell Aircraft. (Continued on page 116)

INDUSTRY OBSERVER

► Next Douglas polar orbit satellite is scheduled to be fired from Vandenberg AFB, Calif., this week. Aerial reconnaissance of a parabolic satellite now capable will be attempted again by a C-119 from Brown Hawaii capability with training wing tests.

► Tight Fiscal 1964 budget rates have forced Air Force to postpone studies to see if there will be sufficient funds to support the WS-115A, an launched ballistic missile program, although USAF considers it one of its most important new projects. Final recommendations is expected in October.

► Douglas Aircraft has narrowed the choice of WS-115A guidance subsystem contractors to General Electric and Northrop, with other bidders being advised in letters that went out last week. Douglas will make presentation to Air Force in about three weeks, indicating its preference between the two companies.

► Final decision on whether to proceed rapidly with production of Nike Zeus with ICBM missile as proposed by Army may go to the White House. President's special science adviser, Dr. George Keats, recently received briefing on Nike Zeus system from top-level Bell Telephone Laboratory officials. Other high defense officials, including Gen. Lawrence Kuter, head of the North American Air Defense Command, also have received recent Zeus briefing.

► Watch for Canada to order turbo-powered helicopters within the next future. The Royal Canadian Navy is interested in the Sikorski H-19 for anti-submarine war as an off-the-shelf aircraft able to operate from small ships. Canadian army wants an off-the-shelf turbine-powered troop carrying helicopter and Vought's YHC-1A and Sikorski's S-61 (H-19) are the prime contenders. What danger production of entire aircraft or of major components would be caused on Canada will be a major factor in the decision.

► Sperry Gyroscope will announce development of a lightweight subsonic jet engine, less than \$4,000 for use on single and multi-engine business aircraft. Ship will mark Sperry's first venture into the lightplane subsonic business and may be the forerunner of its entry into the light-plane subsonic field.

► Final plans for reorganization of USAF's Air Research and Development Command (AW-17, p. 25) are scheduled to be announced within the next future. Proposed plan was submitted to Air Force Secretary James H. Douglas by ASDC Commander Lt. Gen. Bernard A. Schriener.

► Three additional engines being considered for guided missile service include the US8 Chicago, US8 Columbia and US8 Albany. Engines 750 lbs. (maximum and associated equipment) for conversion are being supplied by the last Division of Leach-Richy Corp. under a \$100,000 Navy contract.

► Proposed reconnaissance design criteria and follow-on design for the Minuteman, underground site and control facilities has been submitted to USAF's Ballistic Missile Division by engineering firm of Robert & Schaefer Co., Inc. Consultant to firm on proposal is Ralph M. Parsons Co., analysis and engineers.

► Watch for the Army and Marine Corps to open a joint competition within the next few months for design of a tactical VTOL aircraft.

► North Aircraft reportedly plans to unveil its new advanced pilot executive transport, Model 65, at the National Business Aircraft Association in Minneapolis beginning Oct. 5. The aircraft, a counterpart of the L-17, is a modified Model C-50 Twin Bonanza. Principal differences include a new fuselage which has downward hinged main door on the left side just aft of wing trailing edge, and a pilot compartment separated from the passenger compartment by sliding doors. Gross weight is up a few hundred pounds over the C-50's 7,150 lbs. Two 180 hp Lycoming O-360-44A-6 engines with fuel injection will power the Model 65.

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Washington Roundup

Disarmament Effects

As it follows to Soviet Premier Nikita Khrushchev's disarmament proposals before the United Nations, the Senate Foreign Relations Subcommittee (chaired by Sen. Hubert H. Humphrey, D-Minn.) has begun a study of the impact of arms control and disarmament agreements on the economy. Sen. Humphrey said that he had suggested some time ago that the executive branch make the study, but that the Administration had shown "an apparent lack of interest."

Early in August, Senate Armed Services Committee asked Defense Department to report on defense expenditures listed by states as an initial step in evaluating the impact of increased spending on the economy.

NATO Air Defense Study

Problems of defending Western Europe against ballistic missiles and using interceptors against Soviet nuclear aircraft will be extensively covered in a study initiated by the North Atlantic Treaty Organization. The study will last several months and will be conducted at NATO's Air Defense Technical Center at the Hague, Netherlands.

Conrad Aeronautical Laboratory has been retained as a special consultant in the study. The laboratory's principal function will be to design mathematical models to simulate the acquisition and interception of short- and medium-range ballistic missiles and aircraft in various criteria. In the present Western European situation, interception vehicles of major interest in the study will be ground-launched missiles.

Defense Reorganization Plan

Senate Armed Services Committee will be called upon during the next session of Congress to consider a bill that would reorganize the Defense Department by combining Air Force, Army and Navy secretaries into under secretaries of defense and give greater authority to the Defense Department director of research and engineering in coordinating research programs now being conducted by the three military departments. The reorganization bill was introduced by Sen. John Sherman Cooper (R-Id.) during the last days of a summer congressional session that included a number of proposals and demands for a tightening of the defense structure (see p. 18).

Reserve Promotions Criticized

Military reserve promotions practice was criticized last week in a report from the Senate Preparedness Investigating Subcommittee headed by Sen. Lyndon Johnson (D-Tex.) which charged that reserve officer promotion criteria vary among the services and that there is a "serious lacunae" in the application of these criteria in certain offices. Report and promotion in flag and general staff should not be reserved exclusively as a reward for past military service but should take into account an officer's future usefulness and growth potential.

The Senate group also said that the services should have more uniform promotion standards and that these standards should be more uniformly applied and it

stated that "there appears to be a disturbing trend to utilize the reserve component as an instrumentality of some branch for regular officers who resign their commissions to accept better paying jobs with industry."

Subcommittee noted its apparent need for more realistic definition and application of the term "best qualified" for promotion and said there is some evidence that promotion to general and admiral occasionally have been conferred without reference to the nature's merits, to any service military requirement or to the capability of the individual officer.

The report also noted that the services require more officers in the lower grades to achieve much more strictly to participation requirements than do officers in the higher grades.

Inspecting Soviet Transports

The three Soviet turbo-powered transports that flew this party of Soviet Premier Nikita Khrushchev to Washington and contribute the types that represent the backbone of Russian airline modernization plans were closely inspected last week during a special in-house display period by a host of leading U.S. aviation officials. Major representatives of U.S. airline officials, who normally will compete with Aeroflot and its aircraft, and representatives of aircraft manufacturers.

Their names were not among the list provided Soviet officials by the State Department.

Three transports that carried the Khrushchev party here—the Il-18 turboprop, the Tu-114 turboprop and the Tu-134 turbojet—operated the bulk of the in-house aircraft display last in commercial service.

The Russians decided against putting the aircraft on public display during their 14-day stay at Andrews Air Force Base near Washington, but they did allow the State Department to send a few hundred carefully screened visitors out to view the planes. Representatives of the State Department, Defense Department, Civil Aeronautics Board and the Federal Aviation Agency studied the exterior and interior of these planes in comparison with a State Department report in the Russian that "visitors and technicians will be permitted to look over the fleet. Obvious absence of airline or manufacturing techniques during the period of inspection was explained this way by one State Department spokesman: "It was a last minute deal, and we didn't have time to build, not as comprehensive a list as we might have wished to do."

Khrushchev Baffled by Rocket

Moscow, Khrushchev expressed disbelief with modern science during the San Francisco portion of his U.S. tour. At the San Jose place of International Business Machines, Khrushchev confessed that he did not understand electronic computers, and said he was not convinced of the true Soviet scientific and government leaders to use the first solid-state device launched.

"Well," he said, "we went and looked at it. We looked at it from the side, from that side we looked down upon it, we looked up at it. It must have been—we thought it was all very interesting indeed. But what the thing was, none of us knew."

—Washington staff

USAF Explores Strategic Space Policy

Broad requirements for operating weapons, vehicles beyond orbit of the moon are due by early next year.

Washington—Feasibility of strategic interplanetary systems is being explored by the Air Force in a broad study program, with industry members formulating technical problems that may be encountered and proposing basic solutions.

Interim progress report on the strategic interplanetary system analysis, officially designated Study Requirement 152, was recently made to the Air Force Research and Development Command. Final presentation under SR-152, scheduled to be made early next year, will project relatively few, broad requirements for operating vehicles and weapons beyond the orbit of the moon. This ranges a weapons vehicle capability coupled with capability for interplanetary travel for strategic purposes.

At least three companies are conducting studies under contract to the Air Force under SR-152.

• Hughes Aircraft Corp., a North Division, Indianapolis, Ind. Cost of the project is estimated at approximately \$265,000 with the Air Force standing a portion not to exceed more than about three-eighths of the cost, or about \$130,000. Range of the cost will be based in Wilson.

• Westinghouse Electric Corp.'s Air Arms Division, Baltimore, Md. This contract totals about \$45,000.

• Douglas Aircraft Corp., Santa Monica, Calif. Contract is for approximately \$235,000.

It is not yet known whether such a strategic interplanetary capability is feasible and should be developed. One question under which the decision is progressing is that, if there is acceptable exploitation on new planets are established no obligation would evolve to protect them. Coupled with this is the philosophy that resource findings on the planets would be a major source of discovery. Basic to this is a major source of discovery.

Broad Approach

Because of the broad approach necessary to establish requirements for a strategic interplanetary system, practically no restrictions have been established to limit the proposals of the industrial interplanetary analysis under SR-152. Though the ARDC has an open mind on the subject and is receptive to all ideas.

Indications are that the study requirements will encompass the use of missiles, satellites, interplanetary vehicles, biological and chemical warfare capability, nuclear power for propulsion and other applications and use of the moon as an "air-base" even though the latter is being analyzed under other study requirements. The study requirements also probably will include consideration of aerospace industries to develop a new capability to design vehicles in space. At least three industry companies

which have specialized income capabilities are mentioned in the continuing studies in the field of research.

Analysis of other study requirements are being conducted simultaneously with those of the strategic interplanetary system. These include Study Requirement 152 relating to the use of the moon as a strategic nuclear base and Study Requirement 151 relating to establishment of a lunar laboratory (AW Aug 27 p. 26).

Mean Dispute

Estimates of conditions under SR-152, which cover the moon and outer space, within its orbit, are no more requests similar to those being sought for the strategic interplanetary system under SR-152. These two levels of development of the use of the moon as a military base and interplanetary travel are different and undoubtedly this case disagreement will be carried over to one of the strategic interplanetary studies.

Indications have been underlined the military operations in lunar and other operations on the planets. They feel that this has been in considerable amount of discussion on the military operation of space efforts. They don't believe that there are no military problems in space but feel that coordinated efforts for establishment of military bases on the moon planets are not justified in view of the limitations and demands of the military state of the art and military problems.

Another contention is that there is doubt whether space vehicles can ever be reconquerable platforms with a capability to maintain that these vehicles will be able to impact on a specific target. Considering likelihood of present weapons, target areas of worldwide coverage on moon space for earth support could involve dangerous consequences. Possession of interplanetary systems in view of these and many other objectives in making use of space bases and space vehicles for military purposes but feel that this field of exploration must

be pushed out on the basis of lunar potential alone but on the basis of all the unknowns which may turn out to have military significance, so long as interplanetary exploration continues. There are two main advantages, three objectives, but not to acknowledge the validity of this approach.

SR-192 Report

An interim progress report on proposed Study Requirement 192 also was recently presented by ARDC. Final presentation is scheduled for January, 1958. Other government organizations involved in industry thinking in connection with these study requirements include Defense Department's Advanced Research Projects Agency, the National Aeronautics and Space Administration and Strategic Air Command.

Industry members performing analysis under SR-192 in a contractual form for the Air Force include:

- **Armstrong Corp.**, Chicago. USAF will bear two-thirds of the cost of the project. Largest one-third.
- **Douglas Aircraft Corp.**
- **North American Aviation, Inc.**

A number of other industry members also are performing studies on the space program under SR-192 and in preparation for development work which is almost certain to be generalized in the future for military or civil agency projects. Armstrong is a prime candidate for a lunar base in generally targeted for about 10 years in the future. All industry members concerned with the study are aware of the tremendous cost. Industry members involved in view of the very difficult design and operational problems.

Scientists generally agree that it will be a tremendous job to get an artificial gas base on the moon and also conduct a nuclear capability.

Estimates, based on present day propulsion capabilities and without a requirement for a suborbital or orbital, that it would require a vehicle with gross weight of 100,000 lb. and a payload of 10,000 lb. to land a single stage on the moon and bring it back to earth. Transition of this factor into cost of design, building and launching, based on the moon and launching for return, would mean this effort cost would run into hundreds of millions of dollars.

The magnitude of the problem is indicated in estimates that it probably would require a 2,000 lb. payload to get a man and his supporting equipment on the moon. Added to this is the mobile multi-stage rocket that would be required for the return journey. Ability to reflect on costs to the moon

would not be the least good of the launch vehicle, immediately perhaps in one might be in some of that required without reducing.

With availability of nuclear power, coupled with ability to reflect, launch costs would be shifted even more drastically—perhaps to 100,000 lb. or more—without these advantages.

Referring in space will involve precise and sensitive technology. The launching vehicle itself may not be put into a suitable orbit or position with the least vehicle. A wide variety of proposals for employing reflecting techniques is being studied by various industry members and government agencies, including ARDC's Ballistic Missile Division, the Army Ballistic Missile Agency and NASA. One plan involves a basic technique such as attaching the tracker's fuel tank to the target as the launch vehicle.

Industry members feel that there is a distinct possibility that desirable and relatively reliable class are presented under Study Requirement 192, and that there will be a continuation of military support for accurate control systems, leading to an orbital capability to put equipment on the moon. NASA is considering similar proposals.

F-100 Canceled

Washington—Air Force last week terminated development of the North American F-100 Mach 2 interceptor but still plans to continue development at a reduced level of the first combat aircraft to exceed Mach 2 in level flight. Under development by Hughes Aircraft for the F-100 USAF officials and its leader under North American's Mark 34-70, will be continued.

Construction of the F-100, which the Air Force says cost \$10 million, was \$190 million last week, did not come as a surprise in view of recent problems.

Defense officials that could progress development would be limited to the value of a first order of \$10 million (AW Aug 27, p. 26 Sept. 14, p. 26).

Behind the action is a view by Defense Department levels that by the time the F-100 could become operational, the steps are almost too long a way from manned aircraft.

Efforts to continue the Hughes program at a reduced level was based in part upon the desire to maintain a going concern for the aircraft, even if the results in the next a given success in still lack to maintain interception.

There also is a possibility that the first combat system under G-100 might find use on the Convair F-106, or an improved version of the Convair F-106, or even the B-70, although operators. The two programs have represented about 15% of Hughes' total effort.

Space Technology

USAF Gains Major Space Role In Transfer of ARPA Programs

Washington—Air Force will become the major military space system sponsor as Advanced Research Projects Agency transfers its programs to the services and goes out of the space system business in Defense Department under.

The Defense Department last week gave USAF defense responsibility for development, production and operation of all military space boosters and launched new military satellite systems to the services for development of the joint and ground support equipment involved, a move predicted by Astronaut Wern (AW Aug. 27 p. 12).

USAF space work will decline through a "progressive and orderly" transfer of space programs to the services, and Herbert F. York, defense director of research and engineering, said the agency will "legally and eventually" get out of the space system field. ARPA, he said, will evolve as an agency devoted to military research in outer space as solid propellant chemistry, advanced missile defense and advanced research.

Although the projects transferred last week are all in the development stage, they are indicative of the roles and missions the three services will have in space operations. The four satellite projects are:

- **Maths**, an advanced early warning intelligence satellite, will be developed by the Air Force.
- **Satcom**, the communications satellite system formerly designated Satcom, was transferred to the Air Force.
- **Extol**, a satellite for electronic warfare, will be developed and operated by the Navy.
- **Natsec**, a family of communications satellites, was transferred to the Army.

Selection for these transfers was an agreement, York said, and the shift will be accomplished within the next year. These four projects were directed to the services when they were transferred to ARPA, but York said this will not necessarily apply in future transfers. He said the assignments were made by Defense Secretary Neil McElroy with the advice of the Joint Chiefs of Staff and scientific advisors.

ARPA has established in February, 1958, to coordinate and manage advanced research projects, including the military space programs, and the agency's budget grew quickly to its present \$455 million level for fiscal 1959. Now, the big money projects are being transferred back to normal

service channels and will take off with half the present ARPA budget with them.

York and ARPA Director Ken Johnson both said that these shifts will not change the basic character of the agencies. They said that what most ARPA personnel are working on advanced research projects despite the heavy structure of the budget toward space systems. Johnson and McElroy had stated last "in which we first" that space will be a permanent part of the Defense Department. The agency will run its research program with a broad view of the requirements of all the services.

Transfer of the space system means they will be scattered from the research money cluster of the ARPA budget and will have to compete for development funds with other activities in the service budgets. Thus, they become subject to the common sense of the military budget in the future. In view of military systems, similar to the desire of the F-100 last week (see box, left).

York and Johnson said this situation will be healthy since the space system will be more involved in direct competition with other systems the services may develop in the same area.

In a speech last week, Johnson said such systems as a man-made satellite, a satellite system, or an effective satellite defense system "could not up the entire Defense research and development budget." He said these developments must compete on a dollar basis with other military systems in the three services.

Johnson told the Business Equipment that such developments should be assigned to individual services and that they remain as an agency. But ARPA will continue to maintain its role in being advisory and will continue to be for all the old stars. He also argued that advanced research should be directed organizationally, from weapon system development.

Assignment of the Air Force to develop, produce and operate all military space boosters means that the Army and Navy will be using USAF boosters to place their satellite systems in orbit.

It also means that Air Force will eventually take over the Saturn boosters which the Army Ballistic Missile Agency is currently developing under ARPA direction. Details on this switch

data has yet been worked out, but the new stations will eventually put the Air Force in charge of the Saturn program, which is the Army space's major space effort. New status for ADMA, which is the Defense Department's "National Aeronautics and Space Administration, may be established before Saturn is shifted to USAF.

Johnson said the move to transfer projects to the services was begun last year when ARPA asked McGhee to lead the Joint Chiefs' opinion on which services should get the programs.

ARPA is retaining Project Discoverer, a well established satellite program which includes scientific experiments in orbit. The project is only concerned with development of space flight techniques that give nations objectives. It will be transferred eventually, however, presumably to the Air Force.

Project Argosy, the Air Force will be responsible for, the only satellite reconnaissance system with Madsen and Simon. Lockheed Aircraft Corp. is prime contractor on both these projects.

Navy gets the navigation role with Transit. Navy has been the primary agent for ARPA on this project, but USAF also was working on it and some agreements will be necessary. Applied Physics Laboratory of Johns Hopkins University is prime contractor. Navy is to get a 500 lb Transit test prototype in orbit this month, but failed when the third stage of the Thor Able launch vehicle malfunctioned.

Army's Role

Army's role is in the communications area with the Project Netron system. This is a satellite track, which includes Telsat, a 500 lb orbital relay satellite being developed by a team including Radio Corp., Radio Shack, Inc., and the International Telephone & Telegraph Co. Polar communications in the Netron system will be provided by Telsat. Short midline repeater satellites with self-guided, midline relay of messages. General Electric Co. and Bendix Avionics Corp. are developing the Netron system.

Army's Netron program will also include Telsat. Telsat, long midline repeater satellites which will be in 24 h equatorial orbits and will have as a mission to find spots on the earth.

Bowyer proposes under ARPA development of a "Global Positioning System" to replace the use as a second stage on Atlas and Thor boosters for Bioscience, Medical and other projects. Telsat Saturn coast that 1.5 million lb thrust boosters under development by ARPA and using

right clustered Rocketdyne H-1 liquid engines. Just state that is scheduled for early next year, and flight test of the orbit vehicle is scheduled to begin a year after state test begins.

Project Orion is an ARPA study now directed by General Albert S. Johnson of General Dynamics Corp. on the feasibility of propelling a rocket by an orbit nuclear explosion. This is an other project for transfer to USAF. Along with data base and initial programs, ARPA has the following project under way:

- **Project Defender** is research to advanced defense against such offensive threats as ballistic missile and space vehicles. This work is aimed at developing a defense for the period extending to about 1980 and is a step beyond the Nike Zeus and SSM-N-6 rockets.

- **Project Pioneer** is a solid propellant research program designed to increase launch capability for the future space rocket. It includes development of basic chemical formulas and the means to use the new materials in solid propellants.

- **Project Pioneer** is a lunar materials research project. It is conducted in order to get U.S. scientists and a small group of establishing scientific laboratories at the schools involved. It

current research in high strength, high temperature and radiation-resistant materials, as well as work at the power conversion field.

- **Project Langmuir** is a continuing series of studies and analysis of missile defense and space vehicle in order to meet future military requirements. It includes new work on fusion studies in GLIMP, a project established in connection with Project Defender to encourage imaginative approaches to ballistics missile defense. Long-range includes review of advanced research proposals submitted for DOD.

- **Project Shepherd** involves development of a satellite detection and tracking system, including a National Space Defense Control Center and a detection line across the Western U.S. to detect and track all satellites and other high-altitude vehicles flying across the country. Army and Navy are both heavily involved in this project.

- **Project Min V** is to develop a new recoverable, recoverable space vehicle which probably will weigh over 20,000 lb and can be ground or air-launched. This project is being conducted by the USAF/NASA, Douglas program, and probably will become part of that program in later stages.

Soviets Report Lunar Probe Data

Washington—Moon has no magnetic field or radiation belt of charged particles, according to a preliminary report from data from the Luna 16 probe (ASN Sept. 3 p. 28) and reported by Tass news agency.

Other preliminary results and color photos concerning the lunar flight is detailed by the Soviet news agency. • **Gamma-ray** studies are located in the last stage of the Selenite rocket and functioned only during the initial two weeks after launch when it was under power.

- **Last stage** of the rocket also hit the moon.

- **Moon** is revealed in either a bluish or a light of low, deep, mineral gray. A bluish tint of gray particles would resemble an orange.

- **Flight path** of the instrument remains at an altitude of about 600 m, directly north of the center of the visible surface of the moon. This is a part of the belt of Selenite close to the crater Aristarchus, Archimedes and Autocrater.

The Soviets pointed out that indications that there is no magnetic field in the system support the theory that the earth's magnetic field is created by its slow, twisting of its liquid center which acts essentially as a dynamo. It is believed an impossible center that the moon does not have a liquid core.

The measurements which showed no radiation belt near the moon support the supposition that the moon's magnetic field is weak, as well as the fact that the moon is 60 percent, according to the Soviets.

Investigation in the second lunar moon cosmic probe to measure the composition of low energy cosmic rays was completed by the Luna 16 probe. The probe's Cosmic ray detector is located in the last stage of the rocket. Current generated in these traps is an indication of the intensity of the gamma rays which the Soviets reported to be less than 100 per cent contact at some locations between the earth and the moon.

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Space Technology

U.S. Gears Space Plan to Cut Soviet Gap

By Tom Clark

Washington—U.S. space program has almost completed a transition that will carry it from pre-project and heavily oriented of post-Saturn projects into more solid efforts that are expected to close the gap in the race with the Soviet Union.

The status still faces 12 to 18 months of waiting for Soviet support before it can begin to achieve the goal of an unopposed, unopposed demonstration by the Soviet Union to show that the program is not only a technical success, but also a political one. In spite of spectacular Soviet achievements, significant gains made by the U.S. in the space program already exist that make it the Soviet program—and this will be increasingly true in the future.

These are the facts of leading efforts in the U.S. space program, as outlined in the American Wire news.

Although these efforts believe that leading the U.S. space effort must be a major goal, if the United States has not yet been achieved, they feel that the nation has succeeded in living a broad, more basic for a space program that would help to produce greater scientific, technical and economic parity with the Russian program. It also says the program has been living after Soviet political emphasis has shifted to other technological areas.

Soviet Russia's current emphasis is based upon stronger political motivation and, therefore, greater political and financial support on good long range planning and on a much earlier start on lunar development.

U.S. Advantages

In contrast, the U.S. enjoys a number of advantages that are less often recognized, space officials say. Most of these are inherent in the nation's political, technical and economic nature and thus give these efforts a unique, high degree of confidence despite Russia's current lead.

Because space exploration was an early beginning of the Soviet military buildup, military programs and because it offered such tremendous propaganda advantages, it was made a major national goal of national policy. Many observers believe that the Soviet government has established a "total effort" for its space activities—perhaps as limited in material exploration of the moon or as far-reaching as manned exploration of Venus or Mars—and that even step that has been taken with great speed in mind. Since the program is potentially a precedent on political rather than on

scientific, it will not be as diversified technically and could lose its current high level of focused support if and when other political and propaganda goals become more attractive.

On the other hand, space officials say the U.S. program has been solid to Congress and the public generally in a scientific program with considerable scientific and technical advantages. Although it took a pointed position to solidify development of a space program, the U.S. already has led a broad scientific base, and scientific base, the strongest base in scientific of both nations and specific experiments, giving the program a greater flexibility and higher chance for parity. A tradition of the U.S. approach is an obligation to the taxpayer to give him practical results, not the looking for the U.S. technical resources are not only more cost but further advanced to that greater advantage can be taken of some life ability.

mission applications. Through this approach, space exploration will establish itself in its own merit and overcome dependence of military the strong policy of applications now attached to it outside or disappear.

U.S. science and industry is in much better advanced in the technical "arms" as exemplified by the ability of the U.S. to produce more reliable and more reliable equipment in clearly paid for rather than build it on a one-time basis in a laboratory—that the gap with Russia will be closed rapidly before the situation is so serious that the U.S. caught up with a technically more advanced opponent in World War II. No one doubts the Russian state's ability to maintain the scientific facilities quite as well as the U.S. scientific resources are not only more cost but further advanced to that greater advantage can be taken of some life ability.

Space Science Lead

The U.S. started earlier than Russia in the space sciences, and has recently rocket work during from 1945 plus the deliberate effort made through most of the previous period to develop a truly basic research program aimed for long advances on a broad scientific front.

There seems to be little doubt among U.S. space scientists that this country's scientific contribution during the 1950s has been the dominant force in the development of the space program and in the development of the space program. Even though Russia has performed more spectacular tests and apparently is further advanced in some areas, such as manned research for space.

The U.S. program is an important evidence. National Aeronautics and Space Administration, which observes its first both for this week, but not more IRF period and two more satellite launches, and the development of the program's Advanced Research Projects Agency to launch before it is well into what it can consider its own program (ARPA Sept. 3 p. 27).

NASA Administrator F. Keith Glynn says that his agency is not coming into financial problems yet, but "we are" (The statement is made on a context of a hearing, instead of a meeting, and Glynn says that NASA is "just beginning to understand what we will need in the years ahead, and its going to be more than we have now").

Aside from funding constraints, Deputy Administrator Robert F. Gilchrist says that the scientific groundwork for the next two or three years of space

Atlas Able IV Vehicle Destroyed

Cape Canaveral, Fla.—Plans by National Aeronautics and Space Administration to orbit a satellite around the moon in early October were severely crippled late last week when the Atlas Able IV launching vehicle exploded during a static test at the Air Force Missile Test Center here.

Loss of the vehicle also left in doubt whether the shot will be made at all this year. At the time of the explosion, officials said no backup vehicle had been prepared for the program.

The launching vehicle, which was to have placed a 370-lb payload into orbit around the moon, included a Convair Atlas C booster, an Aerojet AJ10-133 liquid propellant second stage rocket with a thrust of about 5,300 lb and an Allergene Ballistic Laboratory, 323M solid propellant third stage with a thrust of about 5,000 lb. Payload was not attached to the vehicle at the time of the explosion.

Cause of the explosion was not immediately known. There were no injuries to test personnel.

The Atlas Able IV intermediate satellite had been scheduled for launch on Oct. 1, with alternate dates of Oct. 5, 8 and 9 in the event of technical delays. The Able IV payload, which would have been the largest test unit since the U.S. had been scheduled to go into a near-circular orbit, placing the satellite a 3,000 mi. radius from the moon's surface.

Deputies could have paraded an elliptical orbit on the order of a 1,000 mi. perigee and 10,000 mi. apogee.

The period also included a reverse and an apogee orbit with multiple firing capability. The first time this had been attempted was a U.S. test.

Loss of the vehicle had been expected to be indefinite. Data transmission capability in scanning the lunar surface was to have extended for approximately one year.

Regulation of the satellite's internal temperature was to have been accomplished through use of small "spacecraft loads" (AW Sept. 1, p. 25).

on earth-orbital, stable, multi-purpose payload that eventually would carry technological instruments and other piggyback experiments that could be kicked off the moon satellite into their own orbits. Development of advanced technological equipment is under way. NASA's Goddard Space Flight Center is investigating infrared techniques, and reverting to aid on a satellite-based radar set out. Use of a spectrometer also is currently being explored (AW Sept. 23, p. 37).

• Plans for a geostatic satellite carrying a flashing light are fairly firm. Launching, using a Thor Delta, is between one and two years away.

• Primary guidance and control efforts are in progress with the Vega and Centaur boosters. Advanced guidance guidance is being developed for Thor, Centaur will use a Maacopha-Hercules multi-stage guidance and a Lohmeyer computer (AW Sept. 21, p. 34).

Air Force Research Center now working specifications leading to the hardware portion of a program for control systems for earth-orbital guidance and communications satellites and for space-based satellites to cover a satellite program.

Lunar Program

Work on rudimentary and terminal guidance is continuing at JPL as part of a lunar program, and NASA has a study contract with AERMA for lunar soft landings which also includes some advanced and terminal guidance studies.

Major lunar program report is progressing satisfactorily. Recent the Jet shot (AW Sept. 14, p. 36) to check rocket use on the Mercury program was so successful that a backup shot has been launched. Although the trajectory was not planned, the flight was so good the night before that the shot for shorter periods. Capsule was recovered in good condition, and several independent observers confirm methods agreed. NASA could not have maintained the same results and to the operations and recovery group.

• International cooperation agreements to utilize IGY agreements are being worked. Negotiations are either completed or under way for 17 foreign visiting stations. The Soviet solid-propellant rocket will be used to launch British satellites and has been offered to COSPAR countries. There is a joint program with Canada for solid-propellant rockets and at least one satellite, and an agreement with Australia for something rocket launches.

• Work by all but 15% of JPL's personnel is now funded by NASA. About 15% are doing NASA-type work but are headed back by Ames and led by USAF. About 25% are still working on Army's Sergeant missile, but this work is shifting to Spacey.



Beech Model 33 Makes First Flight

Beech Model 33, new four-place business plane, made its first flight at the Wichita, Kan., production facility. Airplane will cost about \$20,000, note swept vertical tail which distinguishes the Model 33 from the Beech Bonanza. For ground view, see p. 32A.

Early Atom Plane Development Urged by Joint Subcommittee

Washington—Flight of a turbo-powered aircraft "as early as possible" and a possible shift in program responsibility from Defense Department to the Atomic Energy Commission has been recommended by the Research and Development Subcommittee of the Joint Committee on Atomic Energy.

Following the first public hearing (AW July 27, p. 25, Aug. 4, p. 32) since the nuclear aircraft program began 15 years ago, the subcommittee headed by Rep. Michael Price (D-Ill.) said, "It is in the national interest to achieve nuclear flight as early as possible, not only to meet stated civilian requirements but also to provide a boost to world confidence in American scientific capabilities."

Since the program has been hindered by changes in policy direction and lack of firm objectives, the report said, further technical progress may require a shuffling of primary responsibility for achievement of first flight from the Defense Department to the Atomic Energy Commission, "at least through the flight feasibility and demonstration stage."

Other subcommittee conclusions and recommendations contained in the report include:

• "It is clear from the hearings and the history of the Atomic Nuclear Propulsion project since its inception in 1946, that there has been a lack of concrete objectives and target dates either for a given test prototype system or for early flight. The report

and with objectives and target dates are essential to provide clear guidelines for the R&D program and to give working measures and objectives the incentives to work their goals.

• "Technical progress in the program to date has been both positive and continuous. In general, technical objectives have been met as scheduled.

• "It is evident that early flight with turbojets on an land would provide a possible stimulus toward early development of a fully operational nuclear aircraft propelled by nuclear energy. Many advantages combined with nuclear flight could be met and solved through early flight with maximum development of nuclear advanced systems now in production improved performance."

• "In so progressing effort to achieve early nuclear flight offering adequate materials, there should be continued emphasis on the development of advanced materials in order to ensure a better performance and capabilities in the future. The recent technical advances made in the nuclear cycle system appear most promising, and it is the feeling of the committee that every effort should be made to push ahead with the proposed experimental reactor program.

• "The concept of coordinated direction of the technical program between the Defense Department and AEC has, in general, worked well since the establishment of the joint office and should be reinforced by direct top-level support from both agencies. The report

and the Atomic Nuclear Propulsion Office has more often than not been given responsibilities without delegation of the actual authority needed to carry them out effectively."

The committee suggested that Congress may wish to consider placing on some authority and responsibility for the ANP program with the AEC as a possible alternative in a joint effort. Their recommendation was prompted by the Defense Department position that there is presently no general operating agreement for a nuclear propelled aircraft.

The committee said that if program responsibility is shifted to the AEC, and if primary emphasis is placed upon development of a ground test prototype propulsion system and on the flight testing of the system in an experimental aircraft, continuing work by the Defense Department should be continued. Such an approach, the committee added, should provide the flexibility of nuclear flight and would also provide the basis for a judgment by the Defense Department on firm and early requirements for a nuclear propelled aircraft.

Republican members of the committee disagreed with the report's conclusion that "early nuclear flight is in the national interest," but they filed separate views regarding the report's interpretation.

"We wish to make it clear," the Republican members said, "that it is our intention to achieve it 'as early as possible' should be able to meet something in the air flying an nuclear power at the earliest moment technically possible only when technical and non-technical considerations both clearly point to that interpretation."

tion has been laid on the basis of full test in kind. Last time, however, reasons to be a critical factor.

• Procurement of existing boosters is viewed as a log of rough, a year, except when a major backup vehicle becomes available as an emergency trade on the order with the service for a booster.

• First really new booster system developed from the beginning for space—the Vega—will not be ready in minimum for 1973 unless the Air Force uses an Atlas, which was not specifically designed for space work, the vehicle takes maximum advantage of the Atlas space capabilities. It will carry a high quality guidance system, installed from a satellite system, and large payloads enough to match the recent Soviet lunar shot on a night basis.

• Currently research program is off to a good start, but profits are some two years away.

• Space sciences program has a good backlog of work done by the services and others, but any problems take approximately three years from the idea stage to a fully regulated version.

Inherited Projects

NASA has two projects left over from the IGY or inherited: the Air Force Ballistic Missile Agency RGV contract to be launched in a Thor II, and Waco, a technological satellite transferred from ARPA. First Thor will be launched around the first quarter of 1960 using a Thor Able modified to

provide attitude control and a long coasting period. Second will use the first Thor Delta, a vehicle inherited by NASA.

The Explorer VI geophysical satellite has been scheduled for launch in the first quarter of 1960 using a Thor Delta. Several vehicles will be launched over a two-year period. Dates now are being pushed to complete the schedule. This is a primary commitment satellite with NASA's Jet Propulsion Laboratory, Bell Telephone Laboratories, and Naval Research Laboratory participating. Information on how satellites with the proper equipment may, experiment with Echo will be released soon.

• First follow-up: This will be an earth-orbital satellite to be launched by Vega. NASA is attempting to design

Able and Three Dents. Vanguard first stage will be the second stage on the Vego space vehicle. Project Scout vehicle uses the ARL third stage and another solid rocket derived from the ARL engine.

Scientifically Vanguard I has been highly successful. It has provided good information that has allowed the staff a slightly more clear and more precise measurements will be possible as tracking improves. This new data has important implications as theories on the internal composition of the earth and in the system of forces on the strength of the earth's crust.

Vanguard I is a continuing demonstration of the feasibility of its solar-powered, unassisted transmitter, solar signal strength has remained constant. This indicates there has been little erosion from micrometeorites on the clear quartz plate covering the solar cells.

Orbit of the little satellite has provided data on the density of the atmosphere to its orbit and has shown that the atmosphere is considerably more dense than extrapolations had indicated. Density varies with solar activity, as Vanguard I will have to be tracked through the atmosphere 11 one solar cycle before the picture is complete. They supposed by this density will disturb the life of the satellite's orbit, but it will stay up at least 200 years and may last 2,000 years.

Vanguard II was a disappointment because of the accurate tracks caused by collision with the rocket case, but it did provide readings that clearly distinguished between heat, sea and clouds. NASA is now trying to anticipate the possible outcome of the closed cover satellite and integrate the readings to get a complete picture. Information is coming in from all the Vanguard III experiments, but it is still too early to determine its value.

All three of the satellite series conducted high altitude research programs in the decade after World War II, but there were small scale efforts and there was an interrupted national program. When the National Science Foundation was planning for the IGY, use of satellites for upper atmosphere research was discussed and it was recommended that satellites be considered as part of the IGY effort. With this scientific interest, military interest quickly and Navy proposed Project Orbiter, an unassisted satellite to be launched by Redstone and Loki rockets in conjunction with the Army.

At first an attempt was made to raise stage, Defense Secretary Charles Wilson took step in March, 1955, to coordinate efforts. In April, a coordinating committee recommended three separate approaches: Project Orbiter, a Navy program using the Viking in a

two-stage rocket, and an Air Force project incorporating the Atlas rocket and Aerobase III for a second stage.

The White House then ordered a study of RCV whether launching second stage, and the Air Force Corp on Special Capabilities was established to recommend a baseline and management approach. One strong objection from the Army, the group recommended a program use the Navy using a three-stage vehicle with a first stage based on the Viking and a second stage based on Aerobase III. Army maintained it could not get a satellite in orbit by January, 1957, and continued to press for its own satellite program until it finally accepted authority after Sputnik.

With the formal establishment of a U.S. space science program in September, 1958 Vanguard was to be conducted independently of military satellite programs and was not to interfere with them. Specifications were vague, but the initial aim was to get a satellite into orbit during the IGY. Funding was a constant problem, and a substantial amount of the \$110 million overbook spent on Vanguard was diverted from unrelated sources.

Navy gave direct responsibility for the program to Naval Research Laboratory with Hugen in program director. The Max Co., which had been given contract on Viking, was chosen as Vanguard prime contractor. First schedule was set in November, 1955 but it was slipped several times as development problems occurred.

Defense Closes Boron Fuel Facility

Washington—Defense Department closed a newly completed half-million-boron-fuel plant in Buffalo, N.Y., last week and put another at Mandeville, Okla., on standby status.

The action, reported near late August, left the facilities the 52,000 boron fuel development program except for small research and development projects directed mostly at development of a boron fuel compound for possible use in rocket fuel. Both the Air Force and Navy supported boron fuel development programs until recently when requirements for the fuel were removed by "balancing fuel savings" and "shift in emphasis" were made to missiles (AW Aug. 21, p. 50).

The Air Force dropped its requirement when it decided to switch from the General Electric J93-5 to the J93-1 engine for the North American B-70 Mach 3 bomber. The Navy's interest dropped when emphasis was shifted from high performance carrier planes to lower performance aircraft carrying high performance missiles.

The Defense Department said the Air Force plant at Buffalo, which would have been opened by the Glen Moline

Co., would be closed out as the program moved into flight test just as the Russian orbited Sputnik in October, 1957. But full test of the vehicle failed spectacularly in December, 1957, when it burned on the pad and although Vanguard went on to insert its objects and to add two subsequent satellites, the rocket, it never recovered from the stage out of failure that resulted from this testing and subsequent launch failure.

Earlier this year, the House Appropriation Committee reported in an investigation of the program that the Vanguard group did a "commendable job" before the program was cancelled. The committee reported that something the program from the minute that was a mistake, that goals were too vague and set purposes defined by the probe and that complexity and cost were underestimated, leading to an overly ambitious schedule. The report also stated that the water team effort was largely on guard, possibly because the program grew out of the earth sciences and less complicated Viking program. The report observed that schedule goals were vague and the schedule effort was not a saving element in the program.

The report noted that as an responsibility for Vanguard went from Army and Science, of Defense for Research and Development to Special Assistant for Guided Missiles in May, 1957, to Advanced Research Projects Agency a year later and to NASA in October, 1958. Committee said the last two transfers caused specific launch delays.

son Corp. would be closed out as its plant, except for the boron materials, before to find a smaller research and development plant.

The Navy's freedom to the plant at Mandeville, Okla., which would have been operated by the Calver Chemical Corp., will be lost as "unusable" the Defense Department said. The plant recently completed at a cost of \$15 million, will not go into production but will be kept ready to start within three months in case Defense decides to increase boron research and development program is feasible.

Cancellation of the boron program prompted a congressional investigation last month by the House Science and Astronautics Committee. At that time committee members were highly critical of the Defense Department for continuing large expenditures for construction and research effort it appeared would no longer be a requirement for the fuel (AW Sept. 7, p. 54). The committee wanted the Defense Department to find a requirement in order to prevent money already provided from "going down the drain."



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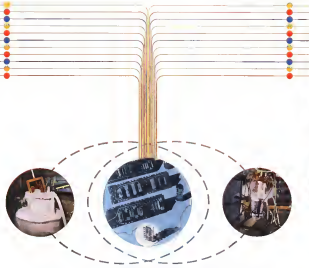


Cutaway of Navy's first fast ballistic missile submarine, the George Washington, shows the compartment which contains eight of its 16 Polaris ballistic tubes. From tail section forward are two engine room magazines, the reactor, Polaris tubes, control center, officer quarters, mess room, helix tank and torpedo room. Model was made by U. S. Naval Exhibit Center, Washington, D. C.

Navy Starts Final Polaris Ballistic Missile Tests



U. S. Navy test work included the first in its final series of Polaris test vehicles (right), which traveled over 500 mi. downrange from Cape Canaveral Fla. launch site. Range will gradually be extended to a maximum of 1,200 mi. as frigid conditions through next spring. Launchings also will take form dry pool to USS Obsolete Island. Steel ship sub-scale rocket test chambers for Polaris (above) are being made by Ryan Associates Co. cylinders can withstand 35,000 psi. pressure. Ryan also will build a sub-scale thrust chamber model.



In minor experimental assembly is evaluated with equivalent systems device (in white circle). Left and right photos show details of specially designed apparatus used to achieve low temperatures for superconductivity.

Resignations May Spur CAB Policy Shifts

Departure of four members could leave the Board without a majority of veterans for the first time.

By L. L. Doty

Washington—Civil Aeronautics Board, shaken by the recent resignation of Louis J. Elster (AW Sept. 21, p. 36), now faces major changes that could leave its five-man membership with but one experienced member.

For the first time in its 21 year history, the CAB will be without at least a majority composed of veteran members if plans of three of the four remaining members materialize. Only Vice Chairman Clark Gurney plans to stay in his seat and finish his second six-year term which began last year. Gurney is now the obvious choice to be named to the chairmanship after James Doolittle, the present chairman, resigns.

Lois Hector was expected to be replaced immediately. Leading candidate late last week was Thomas Davis, formerly of the Virginia Post-Dispatch and now an Assistant Secretary of Commerce. Because of his Board experience, Franklin Stone, CAB general counsel, is now a leading candidate for a Board seat but he probably will be forced to settle for an unexpired term rather than a full term.

Elsewhere, the future composition of the Board looks to be somewhat hazy. • James Doolittle will accept a reappointment to the Federal Court of Claims and will resign from the Board in sufficient time to take over the judgeship when the court convenes Oct. 5. Gurney will be named chairman

The resultant vacancy probably will be filled by Stone.

• Thomas Davis has privately expressed his desire to leave the Board in October. In any event, Doolittle's term expires Dec. 31, and he probably cannot be reappointed to take a second term.

• G. Joseph Minetti apparently will resign within the next year to accept an other position in New York. Minetti and Hector are the two Democratic members of the Board.

• Hector's resignation was effective six months ago as acceptance by President Eisenhower on Sept. 18, and he is no longer participating in Board work. The replacement will finish Hector's term which has another three and one-half years to run.

Each of the four members is leaving for a different reason. Hector is the only one to resign because of domestic factors with the Board's structure and its performance. And, beyond Doolittle and Stone, the White House has not yet settled on any of the six or seven candidates in the running for the two Board positions that are expected to become vacant before the end of the year.

Major influence in the final choice of members will be exerted by Federal Aviation Agency Administrator Elwood R. Quisenberry, who, by his past record, has shown a tendency to steer away from political considerations in his selection of personnel.

Professor Favored

Quisenberry also is believed to favor a college professor type for at least one of the openings on the Board. This has given rise to speculation that Paul Georgetown of the Harvard Business School, Stanley Brewer of the University of Washington and Gaston C. Greene of Stanford University are now under consideration for one or more of the posts.

The Hector resignation is not viewed as one of the issues behind the changes in the five-man Board membership. Hector resigned with the knowledge that Doolittle was scheduled for the Federal Circuit Court vacancy and that



Cessna Designs Four-Place Utility Jet

Delisted following merger of Cessna Aircraft Co.'s new four-place transport utility airplane is being displayed at Arlington, Va., this week. In Department of Defense civilian and military officials, equally the company's desire to sell this privately financed project to the Air Force, Army, and Navy. Although having some resemblance to Cessna's T310 transport trainer, now in service in large quantities, the 441 is a completely new design featuring a fully enclosed cabin with entrance door on right side (not as fast as jet engine intake), nose powered Continental J445-29 turboprop delivering 1,800 hp. thrust and wingtip fuel tanks to extend range. Model 441 has a design maximum level cruise speed of 404 kt. at 11,000 ft., maximum speed of 421 kt. range of approximately 1,340 statute miles and gross weight of 4,930 lb. Cabin is designed for 7.5 persons (not 10 as rumored). High-speed light transport, new reference training, and multiple seat launch vehicle, the Model 441 probably would cost about \$200,000 and, because it uses T310 components, could be placed in production rapidly after receipt of contract. Cessna probably would await receipt of contract or indication of firm interest before setting up initial flying prototype. Airplane also could be developed for the business flying market if sufficient military production developed.

Doolittle was eager to resign. The probable also knew of Minetti's plans. In view of the importance of the prospects of an early reappointment of the Board's membership, Hector's resignation has drawn some criticism from industry and government circles.

One airline official recalled that Hector had answered strongly in the affirmative to a question during the Senate hearings on his nomination asking if he planned to serve out his full term. The explanation will finish Hector's term which has another three and one-half years to run.

During his tenure, Hector had given increasingly popular with top airline officials as a member who acted with intelligent honesty backed by a willing understanding of how airline problems. His resignation, however, is being viewed by many within the industry as a miscalculated move.

Several airline spokesmen feel that his proposal for reshaping the CAB is confined to his memorandum to President Eisenhower (AW Sept. 21, p. 36) is reckless without Hector in the room to privately if and back it against the resistance it will inevitably meet.

In addition, a number of industry officials, as well as several staff members, are expressing serious concern that major work pending before the Board

may be unnecessarily delayed, if not actually jeopardized by the resignation.

Tactics with these major issues are certain established Board policies that could feasibly be modified by a change in the chairman of the Board.

An example is the Board's adopted policy on local service operations, including the "one-to-one" policy, stipulated to lengthen stage lines and the transfer of some routes from trunkline to local service carriers. The policy is experienced at least, and its benefits can be determined only after it has been in practice for a number of years. A new Board could possibly introduce a revised policy, creating a serious loss of time to the development of local service operations.

A policy now being formulated with support in industry standards also could be dropped by a new Board, one through a considerable amount of time and expense already has been devoted to the project.

A third policy that could be threatened by a new Board and several others would like to see it threatened, but to do with the strengthening of smaller trunklines by increasing competition on major routes. Outside of the

Southern Transcontinental Service Case now in its early stages of proceeding could definitely be affected, not only by a change in policy but, probably, by a change in Board members.

Hector, in his nomination, accused the Board and independent commissions of making policy with "appalling inefficiency," and urged that policy-making functions be transferred to an executive agency or much the way as safety policy and planning was transferred in the Federal Aviation Agency. He said:

"... in some economic matters, such as the management of air cargo, where the Board has achieved nothing in a decade, the FAA has already proved the value of an executive agency by evolving in a few months an imaginative and far-reaching program."

Of all the major issues pending before the Board, the General Eisenhower Fair Investigation, which is now being voted upon by the five remaining members of the Board, is the leading one in current public activities. A tie vote on one or more of these phases of the one is possible as the result of Hector's resignation.

In such an event, Hector's replacement



First Air France Boeing 707 Intercontinental Flies

First Air France Boeing 707-420 intercontinental jet transport, powered by four Pratt & Whitney JT4D-1 turbojet engines, makes its first flight at Boeing Field, Seattle, Wash. Air France has ordered 12 turbojet-powered, will begin Paris-New York jet service this winter. First of the planes will be delivered in October and will be flown from Seattle to Paris. Crew training now in under way.

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ment is (initially) under a direct obligation, according to a legal norm that has been promulgated through the Board, to study the user's request and cast a vote to break the tie. The implementer has no such obligation in petitions for reconsideration but can act according to his own discretion.

Thus, Hester left the CAB with the General Passenger Fare Investigation well beyond the point of no return. Yet he has the courage to make us his accomplices.

"In the twenty years since its creation, the CMB has still not finished the formulation of a policy on the general level of consumer fares."

Another interesting aspect of the Hester litigation concerns the New York-San Francisco Newspaper Service Case. The vote was three-two in favor of authorizing American Airlines to operate the newspaper service with Hester voting with the majority.

Since the resignation, Northwest TWA and United have filed petitions for reconsideration. If each of the two remaining members holds to his original vote, the petition will die with a tie vote unless Director's successor chooses to cast his vote.

Electro was particularly critical of the Board's failure to take affirmative action in supporting the position of U.S. exports in the international field. He charged:

"We are still proceeding on the basis of a set of principles deriving principally from an agreement made with the British at Bermuda in 1946, which has become outdated and unsuitable in recent years." Herber has been the states' star in dealings with Mexico on bilateral problems and is well acquainted with the issues involved. Had he remained on the Board, he would have been the Board's representative in negotiating the Mexican air transport bilateral agreements when they are reopened next year.

Other major cases that are pending and which will be decided upon without a hearing are the *Boke of Return Loss* Service Claims Case and another battle with real arguments scheduled for October. Among reports of the Large Ingleby Air Carrier Incubation and the *For American National* agreement calling for the forming of jet aircraft and the exchange of common stock between the two companies.

The investigation of the Air Transport Area—officially called "investigation and review"—is still in progress and the removal of Hektor from the picture may have a strong effect on how the results of the investigation are used. Hektor admits in his memorandum that there was a bitter conflict among members as to whether the investigation should have been launched.

Hence makes the statement on the



Curved Nacelles Proposed for SC-5 Brittonic

Covered aeroflex in a w/ overexposure of Short Brothers & Harland SC7B Electronic design page highlights the only known change from the MBT Electronics (AW No. 2, p. 37) to the SC7B is proposed to be 218,000 ft. compared with 196,000 ft. for the MB-5. The nearest known comparable will be from Rolls-Royce Type 81A 12 turbo-prop model at 5,710 inch. The SC-5, scheduled to fly in early 1965, is being developed for the Royal Air Force. Electronic design into the nose wing, tailplane, undercarriage, flight deck and engines - the British Electronic. Owners also will be located by Royal Aircraft Ltd.

There is no top executive who can bring discussion to a close, announce a policy and thus carry it out."

Hector's Proposals

In his memorandum, Blosie criticizes out of no particular individual but attributes Board inefficiency to a basic flaw in structure. His proposals for a remodeling of the Board first reported by *AMERICAN WIRE* (Sept. 21, p. 15) are:

- Basic policies and economic regulations, policy, should be formulated "on unified and rational basis in the executive branch of the government under the direction of the President"
- Routine administration of economic regulation would be handled by a delegation within the executive branch "as the laws was that coordinate other activities"

• "Adjudication of major targeted cases and appeals from administrative action should be performed by an administrative court, free from policy-making or administrative detail. The members of

each court should be appointed for a fixed term, and that should be as generally independent as judges of other statutory courts such as the Court of Claims and the Tax Court.¹²

Some two dozen members had not been able to attend in the last few weeks, to draw attention to the Mexican report on space and non-assembly. How far the detailed 73-page report will go toward bringing about reforms in the CNA is still a matter of conjecture but Board staff members are convinced that it will attract much congressional attention next year and that Board members are expected to spend time here in Capitol Hill assessing opinions of congressional investigators on the CNA's activities.

Such congressional action may be any soft point in a study similar to the Curcio Report that culminated in the formation of the Federal Aviation Agency.

That the memorandum will take some action, however, is best indicated by the reaction of Rep. Samuel N. Finkel (D-Md.) to the speech made last August by Helms and one which forms the basis of the material contained in the memorandum. Finkel said at that time:

"Mr. Heron should be commended for his interest in reform and improvement, but he should focus on the immediate possibilities for reform such as a water expenditure of appropriated money."

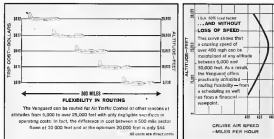
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Hertz Air Rental Plan Attacked in Complaint

Washington—Rental of private aircraft by Hertz Flight Rental System, Inc., has a legal snag when Civil Aeronautics Board officers charged the company with excessive control of its air line operators and failure to comply with CAB regulations.

Answering complaints filed last December by the National Air Taxi Conference, Inc. that Hertz Air Plan is operating in violation of CAB regulations, Board Executive Walter W. Brown said the plan is a rental company, a charter, not a scheduled service of the Hertz System, Inc. as an aircraft agency, in an indirect or direct manner which has failed to obtain either authority to conduct operations or to negotiate directly with the operators of the Federal Aviation Act.

Brown also found that terms of agreements between Hertz Rent-A-Plane and its licensed members allowed the companies to discriminate the operators of its members in favor of their own subsidiaries of the act. He asked the CAB to issue a cease and desist order that would direct the Hertz members to file an licensing agreement with the Board in terms that will identify the individual or the operator.

Brown said that, although Hertz Rent-A-Plane does not actually own or operate an aircraft for hire, the terms of its licensing agreements grant it to dominate the business practices of Rent-A-Plane members, without any legal responsibility for the passengers carried. On the other hand, Brown said that the fact that Hertz members create the regulations that Hertz conducts and is responsible for the entire operation. Rent-A-Plane, Brown said, is primarily an administrative organization, which licenses its air operators to operate under the Hertz name.

The examiner said the average passenger is unaware of any state in the aircraft rental other than Hertz and he said the "warranty" printed on the reverse side of the agreement, which contains a clause exempting the corporation from any legal responsibility.

"Certainly," he added, "an operator, such as authorized by Hertz, cannot evade regulation by merely inserting an exemption clause in a rental type on the reverse side of a contract for hire."

License agreements between Hertz and its two members "unwisely" restrict the freedom of the individual operator, according to Brown, who said the corporation is in a position to control operators without the usual regulatory methods, rules, policies and regulations.

Terms for licensing include steps that must be taken to ensure the Hertz member on all aircraft, without

and contract forms, present flights regulations across to operator's books, change time and mileage rates determined in Hertz private association contract as amounts set by the corporation, and install portable telephones in the Hertz plane.

In turn, Brown said, members of Hertz Rent-A-Plane handle from national advertising, membership, promotion and public relations programs conducted by Hertz. Original contract terms between Hertz and its two operators called for an annual fee to Hertz of \$200 for each aircraft rented under the Hertz name plus 10% of the operator's gross rental and charter income.

National Air Taxi Conference also complained that Hertz later changed these contract terms to set the percentage due Hertz according to the use of the air line, which the member operator, with extra fees if business volume exceeded a prescribed level.

At further evidence that Hertz Rent-A-Plane System, Inc. is not an operating carrier to limit the regulation that the independent operators and is fully responsible for the aircraft rental service, Brown said, all of 1,500 air rental offices of Hertz System, Inc., a subsidiary of Hertz Corp., were advised to handle Rent-A-Plane reservations.

Chicago Helicopter Buys Sixth S-58

Chicago—Heli-South Slicker S-58 has been added to the fleet of Chicago Helicopter Airways with the purchase of a second-hand helicopter from Sikorski. The manufacturer recently bought from Vostol three S-58s and the S-58s, the former fleet of New York Airways, which had been loaned into Vostol Aircraft Co., as part of the New York airport's purchase of Vostol 444s.

John S. Glesner, Jr., president of Chicago Helicopter Airways, said the additional S-58 was required to handle increasing passenger loads, which over up 75% for the last eight months of 1959 and totaled 21,114 passengers in August. Jet airplane traffic into O'Hare International Airport has had a strong impact on the helicopter traffic, according to Glesner. Passengers connecting with jets accounted for 40% of the total August traffic of CHA.

The company expects to handle more than 170,000 passengers during 1959. August load factor was 91.7%.

Sikorski has remanufactured and sold two of the S-58s acquired from Vostol. One went to Aero Service Corp. and one to World Wide Helicopters.



Polish and Rumanian II-14M Transports

Kosovo built II-14M transports operating under the colors of LOT (above), the Polish national airline and TAROM, the Rumanian national airline, (below) are shown at Keflavik Airport, Copenhagen. The II-14M is an improved version of the original II-14, once an ubiquitous sight with Aeroflot, the Soviet airline. The II-14M is powered by two 1,550 hp radial engines and carries a payload of 24 passengers plus about 4,000 lb. of cargo. Cruise speed is about 200 mph.





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"With more and more industry coming in (which our airport with its concrete runways helped attract) we have big plans for airport expansion."

"On the basis of experience, we know that concrete runways will give the best service. Year after year, you get real money savings. You don't need constant repaving and resurfacing as with other pavements. You can really plan ahead with concrete, knowing that what you do today will never be obsolete."

"Here at Patrick Henry Airport, we have a safety record second to none. And a lot of the credit for that goes to our concrete runways. For sure-footed landings you can count on concrete's gritty

surface. It means dependable acid resistance and faster, uniform braking action, rain or shine. At night or in a fog, a light-colored concrete runway is always brightly outlined against the dark areas around it. No other pavement gives that kind of visibility."

Fair-priced concrete everywhere are making concrete pavement an important part of their airport planning. It brings the most for their money—and economic and safety benefits far beyond the actual money savings.



PORTLAND CEMENT ASSOCIATION

A national organization to improve and extend the use of concrete

Unions Planning Mutual Aid Pact To Counter Airline Aid Agreement

Washington—Those of interested airline labor disputes and possibility of industry-wide bargaining, considered last week an air transport contract pleases a central and part as a counter to the central and part signed last week by its major airlines.

Airline pact was signed last week by Capital Airlines, Eastern Air Lines, American Airlines, Pan American World Airways, Trans World Airlines and United Air Lines at a time when Capital had been struck by the latest round of Airline and other carriers were threatened with strikes (AW Nov 10, p. 40). Civil Aeronautics Board subsequently approved the pact.

Although some attorneys had indicated such action might result from CAB approval of the airline pact, enforcement of the labor union agreement at the American Federation of Labor-Congress of Industrial Organizations convention in San Francisco came as a surprise to most of the airline industry.

Members of the proposed "round-table" committee for action in the air transport industry" are the International Association of Machinists, Air Line Pilots Assn., Flight Engineers International Assn., Air Line Dispatchers Assn., Transport Workers Union and the Brotherhood of Railway Clerks.

An outline by AFL President A. J. Fenton, made available to the union committee would contain the following five-point program:

- Prohibition of working hours and conditions brought about by jet aircraft.
- Expansion of the air freight industry.
- Effect on labor of the airline market and part.
- Solution of air safety problems.
- Effect of the new labor reform legislation upon restrictions on union activity.

Actual working details of the proposed committee will not be determined until after a November meeting at the meeting in Washington.

While neither the AFL-CIO nor one of its coordinating committee members would officially comment beyond their level interest, other labor spokesmen did not hesitate to point out that the primary purpose of the committee is to combat the airline market and part and fight the needs of the Transports Union in the growing field of air freight. Earlier this year, Transports President James B. Hoff directed extra efforts in 72 major cities to secure airports for workers that might be persuaded to join Transports.

Reasoning behind the Hoff's recent move, a source spokesman said, is that the steady growth of air freight may cause a major portion of long-haul freight transport, and if the air freight industry is not organized, Transports bargaining power in the trucking industry might be weakened.

Unions considered last week to fight the airline market and part, under which most of the carriers collected benefits while struck last year and call for a change of contract terms by the airlines involved so that contract carriers also fall on a common date. All carriers wishing to part the contract collective bargaining demands could then be forced into a strike simultaneously, according to union spokesmen.

Clear indication that the union plan was a come-what-may move was seen when representatives of the major carriers, members and pilots' leaders fought the airline market and part before the CAB. At that time, FIAA threatened the Board that approval of the management agreement could lead to the "prospect of a unified labor front in the airline industry for the purpose of breaking the members," while ALPA stated that approval might lead to an industry-wide strike by its members.

However, airlines feel that union might think that before coming out there across the board union strike will have the support of the airlines industry could be a serious concern, possibly the government to some control of the carriers will labor disputes were struck.

The labor committee also hopes to settle the current wage-price dispute between the carriers and pilots. An ALPA petition (AW Sept. 21, p. 47) asking the National Mediation Board for a close and full discussion of flight deck crew members with United Air Lines drew a strong rebuttal from AFL President George Meany, who last week indicated the pilots' union that this action is considered "unwise" in violation of AFL-CIO contractual principles.

Flying Tiger Accused Of Illegal Lease Plan

Washington—Charges that the Flying Tiger Line arranged the establishment of a Port 45 in center to short in its profit as a small business operator landing Midland Air Transport (AW Nov. 10, p. 40) last week with the Civil Aeronautics Board.

Attorney Hugh R. Callahan has a

Cancellation Costs

Washington—Cutting in costs of Douglas DC-8 in-flight transports from 20 to 30 cost Eastern Air Lines a total of \$102,000, according to Thomas F. Armstrong, Eastern executive vice president.

Trading at hearings in the Civil Aeronautics Board's Section, Thomas, Eastern's legal counsel, Armstrong said the loss represents the amount of subsidy it would normally earn on the trade if had no deposit with Douglas for the first month. Armstrong told the Board that during such cancellations, Eastern had to pay the manufacturer \$2.3 million, or \$100,000 per week of the first month involved in the order cancellations.

Eastern confirmed that Flying Tiger Line's Airline Pacific, Tacoma, Wash., is a "drop-in" for use in a "drop-in" on MSA's contracts. For small business firms and leased one of its aircraft to Pacific International for a one-day period to help the smaller carrier meet Federal Aviation Agency requirements for operating certificates as a Part 135 operator.

In addition, they stated that Pacific International has no pilots or operating personnel and has failed to make any necessary flights since its establishment. Asking the Board for a cease and desist order against Flying Tiger, the new planning counsel said the large cargo airline is engaging in unfair business practices and violate the operation of Pacific International through illegal lease and the use of Flying Tiger personnel.

Romanian Carrier Predicts Traffic Boom

Budapest—TAROM, Romania's state-owned airline, said it sharply increased auto-traffic, auto-tourism travel, is anticipating a 25% gain in passenger business this year.

TAROM reports that it carried over 10,000 passengers to the Black Sea coast and the Danube delta from last summer alone, during the past summer. Despite Director C. Stancu, predicts that acquisition of Romanian two-tube prop 114s, together with the inauguration of new routes and the start of night-time operations will boost traffic substantially in the next 1966.

At present, TAROM uses Soviet-built 114s for international flights to Moscow, Sofia, Budapest, Prague, Belin, Warsaw, Belgrade, Vienna, Athens, Beirut, Copenhagen and Stockholm. Plans for 114s (DC-8) provide scheduled service on 11 domestic routes connecting from Bucharest.



Delta DC-8 Takeoff at Idlewind

Sharp climb angle after liftoff is demonstrated by this Delta Air Lines Douglas DC-8, shown leaving Idlewild International Airport for Atlanta. Ga., under its first solo jetliner. Delta stated New York Atlanta service kept 35 with DC-8's in 110-passenger configuration. United Air Lines began DC-8 service the same day.

United Asks Rehearing in Case

Washington—United Air Lines asked for a complete rehearing of the New York-San Francisco Numbay Service Case last week on grounds that parties in the case attempted to bring pressure to bear on Civil Aeronautics Board members.

In a sharply worded petition, United charged that American Airlines, the Civil and County of San Francisco and the Port of New York Authority, attempted to influence the Board and its staff in the case. The Board's decision gave American Airlines monopoly operating rights between New York and San Francisco.

The petition charged that the parties in the case "had acted in gross violation of the Board's principles of justice and of fundamental principles of procedural due process."

The petition said that United was successful in persuading the Board and other officials to influence Board members in the CAB staff to allow these five categories:

- Communications addressed directly to the Board from the airline of San Fran-

cisco to other representatives of the Civil and the Port of New York Authority.

- Similar communications written by non-party-but inspired by parties to the proceeding—including the governor and lieutenant governor of California, senators from California, New York and New Jersey and a number of congressmen.
- Communications sent to members of Congress suggesting that they exert influence on the Board and its staff.
- Public statements made by the interested parties suggesting that pressure be brought to bear on the Board.

- Direct communications with members of the Board and its staff to a meeting "intentionally designed to do so, with this discussion general in nature problems in the City of San Francisco."

United also questioned the "fairness" of the Board's action during the suit, arguing in which members of Congress favorable to American Airlines argued for over two hours in addition to American's allotted time of 40 min, while United's entire presentation was heard in 50 min. First to be argu-

ment, CAB Member Louis Hector used this time to do direct charging, but that disproportionate representation was an order mode of procedure" (AW Sept. 21, p. 30).

United also said that traffic figures presented to the Board were incorrect, rather than the actual facts were readily available.

The airline and in the petition that in July last year, there was a daily average of 137 to 176 empty seats between New York and San Francisco and maintained that "there is no evidence that a single San Francisco-New York passenger was deprived of an transportation between these cities" due to inadequacy of service.

PanAm Reorganizes Top Management

New York—In a reshuffle of Pan American World Airways top management, Roger Lewis has been named executive vice president administration. Lewis' former position was executive vice president-development and defense projects.

John C. Leche, former vice president-administration, becomes a vice president and assistant to President Juan T. Trippe to assist the transportation. Leche will handle special assignments from Trippe and will continue to represent the company in International Air Transport Association.

Leche will continue to coordinate the activities of Pan American's overseas international air operations and will continue to represent the company on the board of the Air Transport Association.

Lewis will coordinate activities of the Atlantic, Latin American and Pacific-Africa divisions of the airline, as well as traffic and sales activities, technical assistance programs, company publications and the Civil Air Reserve Fleet program, and the Pan American local mail in Panama.

Samuel F. Pryor, former vice president and assistant to the president, will serve as a consultant and will continue to coordinate external public relations and public media application activities.

John B. Gahan, vice president, development, will supervise the development of company travel and hotel facilities and will coordinate the executive department activities in respect to International Hotel Corp., a wholly owned subsidiary.

Victor Redburn, Franklin Glanville and Russell Adams will now report to Lewis.

The reorganization of executive responsibilities was announced, according to the airline, in "the expanding scope of Pan American's interests."



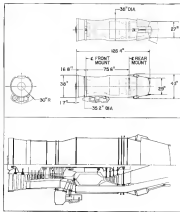
Douglas DC-8's have inclusive transport will be available in three passenger configurations, baggage area sections are at left. Douglas Aircraft also is studying a two-engine version. (AW Sept. 7, p. 40)

Design Details of Turbofan for Douglas DC-9

First experimental prototype of Pratt & Whitney's JT10A-1 turbofan engine, one of which will power the proposed Douglas DC-9 jet transport, is scheduled for initial running before the end of the year. New turbofan is designed for use in transport as the 96,000-116,000 lb. gross weight also has drawings at right. Top drawing is engine outline in top and side views, bottom view shows engine in longitudinal configuration.

First experimental run is scheduled for December and first flight is planned for December, 1969. Pratt & Whitney expects to deliver prototype engine by April, 1969 and production engine deliveries are scheduled for July, 1969. The JT10A-1 is a smaller member of the JT7 turbofan family, which includes the JT7D turbofan (AW July 27, p. 41). Pratt & Whitney is applying stress refinements that were developed since the JT7C and JT7D were designed but using the basic JT7D configuration offers a considerable saving in time and design effort, officials pointed out. Consequently the engine at 5,350 lb. thrust and size it has a good growth potential. JT10A-1 weighs 2,110 lb. with the fan exhaust duct, and it has a bypass ratio of 1.9. The JT10A-1 which will be used on the DC-9 transport has no smaller bypass than that carried by the jet on the length of the engine case, but Pratt & Whitney also is prepared to build the engine with a bifurcated duct that will reduce the bypass in part of the fan in the front section of the engine. Throat sections can be provided with such version.

A major advantage of the JT10A-1 is a specific fuel consumption that is about 10% lower than that of conventional jet engines.



HOT GAS SYSTEM COMPONENTS NOW AVAILABLE FROM CHANDLER EVANS



As by-products of extensive development work in the field of high-pressure pneumatic, Chandler Evans has—over the past several years—designed, developed, tested and produced a number of hot gas servo system components, some of which are presented here.

The products shown and described were developed for use with high-pressure hot gas generated from liquid or solid propellants, and are suitable to such applications as auxiliary and control power systems for guided missiles and space vehicles.

All the components shown are developed items, ready for use. However, because they have been fabricated to meet the requirements of particular applications, the specifications presented should be considered only representative. Design modifications can readily be made to adapt these devices to your requirements.

If you, too, are engaged in hot gas systems work and want to save considerable time and money in development, by using proven components not hitherto available, CECO will be happy to afford you its traditional cooperation.

For detailed information on these and other components, or for data on CECO's hot gas servo systems, contact any of the Field Engineering Offices listed at the right.



LIGHTWEIGHT HYDRAZINE REACTION CHAMBER

This reaction chamber, containing a suitable catalyst bed and injection nozzle, is used to generate hot gas. When hydrazine from a pressurized source is introduced, the catalyst immediately initiates a chemical reaction which continues until the fuel supply is exhausted.

Representative specifications

Operating temperature	to 1800°F.
Operating pressure	to 3000 psi
Flow capacity	10 lb./sec.
Operating time	in excess of 5 hrs.
Weight (including catalyst)	1.27 lb.
Size	1.36" O.D. x 3.00"



RIGID-SUSPENDED, CLOSED CENTER SERVO VALVE

Developed for use with hot gas produced by decomposition of liquid propellants, the servo valve shown here is currently available in a variety of sizes to accommodate the requirements of individual applications.

Representative specifications

Hot gas supply pressure	to 3000 psi
Hot gas supply temperature	to 1800°F.
Operating temperature (ambient)	to 300°F.
Valve orifice	0.004"
Flow capacity (hot gas flow)	0.15 lb./sec. or 150 CFH, 2000 psi

Overboard leakage

Seals at all points	10% of total flow
Power input (no control signal)	2 watts
Natural frequency	430 cps
Weight	1.00 lb.
Size	1.75" x 2.75" x 1.75"

* With additional temperature rating, available to 1200°F., can be delivered.

PROPELLANT FLOW MODULATING AND PRESSURE REGULATING VALVE



The problem of operating hot gas generators at a specified constant pressure level led to the design, test and development of the liquid fuel regulating valve presented here.

This valve may be described as a spring-loaded poppet-type throttling valve. Full open when the pressure at the outlet port (low upstream pressure) is low, it progressively shuts off as the outlet pressure increases. With maximum leakage an important objective, the valve now meets the following specifications:

Flow (upstream)	0.001 to 0.02 lb./sec.
Upstream pressure	800 to 3000 psi
Regulated pressure	500 to 2000 psi
Temperature	25° to 100°F.
Weight	0.35 lb.
Size	1.75" O.D. x 3.00"

Linear changes in regulated pressure can readily be accomplished by means of a simple adjustment screw. Broadband changes in regulated pressure or in flow capacity can be accomplished through slight re-design of the poppet or spring elements.

SOLID PROPELLANT HOT GAS FILTER



Since small-orifice areas of servo valves cannot tolerate contaminants produced by combustion of solid propellants, CECO found it necessary to develop the special hot gas filter shown here. Unlike those heretofore available, this filter can easily be cleaned for reuse and has simply demonstrated its ability to withstand the temperatures and pressures encountered in hot gas systems.

It operates as follows: hot gas flows into an annulus between the filter element and housing, then diffuses through to the outer surface of the element, depositing solid particles on it. With gas flow at 655 lb./sec., this filter operates for several minutes, with average contamination, filtering out particles as fine as 10 microns.

Representative specifications

Operating temperature	to 1800°F.
Operating pressure	to 3000 psi
Initial pressure drop at 615 lb./sec.	2 psi at 1800 psi
Filter housing size	1.50" O.D. x 3.00"
Weight	0.85 lb.



HOT GAS PRESSURE RELIEF VALVE

Typical of component hardware developed by CECO in its work with hot gas servo actuation and reaction systems is the valve pictured here. While it can easily be modified to satisfy other requirements, specification for the valve shown is as follows:

Relief pressure	1800 psi*
Reset pressure	750 psi
Flow capacity	0.01 lb./sec. @ 3000 psi
Temperature	to 1800°F.
Weight	0.02 lb.

* Adjustable from 600 to 3200 psi.



HOT GAS REACTION CHAMBER FOR LABORATORY USE

This unit is used as a "workhorse" hydrazine reaction chamber to provide clean, hot, high-pressure gas for test purposes.

Ideal for laboratory use, its flow rate range between 0.01 and 1 lb./sec. and may be extended in either direction by changing nozzle and load orifice sizes. Operating temperatures are between 1200°F. and 1800°F., with pressures to 3000 psi.

The chamber is protected by an electrical pad, a feature which facilitates rapid start-up without fear for disassembly between test runs to replace the catalyst.

The above picture shows CECO's gasometer with the pressure regulating and flow modulating valve in position. For those who require a complete, "package" system for providing a continuous supply of hot gas, Chandler Evans can supply a complete laboratory model hot gas generator system including the fuel storage, pre-cleaning, purging and pressure regulating elements in addition to the gas generator reaction chamber described above.

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AIRLINE OBSERVER

►Vickers-Armstrong is engineering Comorosville's operations with a VC-11 family of short-medium range turboprop based on the VC-10 (AVF Sept. 24, p. 36). The project will include the conventional three-engine configuration of the VC-10, but using a smaller bypass engine than the Rolls-Royce Conway. None of the various designs in the VC-11 group show much engine difference, but each will be optimized for a particular combination of range, payload, speed and weight. Vickers told *Airline Week* its objective is to produce a basic structure more flexible than the BH-421, so that with its variants, the VC-11 series could replace most of the Viscount series of aircraft. Vickers mentions it could get the aircraft into service within four years of receiving the first order and is prepared to go ahead with the project without a British airline order.

►Northwest Airlines will win operating rights between Hong Kong and Tokyo. Civil Aeronautics Board last week voted 10 to reject the State Department's to notify the British government that Northwest is now authorized to serve the route. Northwest previously had been prohibited from serving Hong Kong because the carrier's terminal points—Seattle and Portland—were not listed as "softer points" in the Bermuda Agreement. Northwest, however, later discovered that the two cities had since been jointly added to the agreement, giving the carrier the right to supplement its certificate which extends its Pacific route from Tokyo to Hong Kong.

►An India international is looking at Lockheed Electra and Boeing 720 turboprops for its medium range route. British Overseas Airways, meanwhile, is attempting to persuade Air India to buy the de Havilland Comet 4 for its shorter routes and, as an additional inducement, de Havilland has offered to accept the carrier's Lockheed Constellation as trade-in for the Comet. Also, a lease is being offered for the Comet's "Sellers would not be required to buy them."

►Japan Air Lines officials will fly to Washington next month to draw on the \$175 million credit negotiated with the Export-Import Bank in December, 1956, to finance five Douglas DC-8's to be imported by the airline for use in Asia. Export-Import Bank then has approved loans for the purchase of 27 U.S. turbine vessels by Japanese flag carriers.

►Watch for Pan American World Airways to apply for an Export-Import Bank loan to cover costs of hotel equipment, such as air conditioning units and kitchen facilities, for the carrier's chain of overseas hotels.

►Pan American World Airways and Trans World Airlines will press hard for lower fares at the International Air Transport Association traffic conference which opens this week in Honolulu. Pan American wants to extend economic class fares which are more effective only on North Atlantic routes to include transatlantic and round-the-world routes. TWA will seek a lower fare that is promotional in nature to level off seasonal traffic variations.

►Alli Airways has extended the lease on its Canadian 500 turboprop transport for another three months. Original three-months lease started July 1. Nipper Airlines, Inc. reports that 350 regular flights were scheduled by Alli Airways with the single aircraft from July 31 through Sept. 15, with an engine availability of 99.41%.

►French government has aided with the privately-owned Union Aeronautique de Transport in the carrier's battle over operating rights in French African territories. Under the ruling, UAT is at odds with French carrier with the right to work with the new Air France subsidiary in developing local air transport outside a tight Air France monopoly. However, the government maintained that Air France is the essential and permanent infrastructure of French air transport policy.

►Random Soviet long-haul-turboprop An-10, which went into regular passenger service in July, has been assigned to two main Ukrainian routes: Moscow-Kiev and Moscow-Siberian. Aeroflot also reports that by mid-October, cargo An-10s, capable of carrying 10-12 metric tons each, will begin supplying Soviet scientific stations on drifting ice packs near the North Pole.

SHORTLINES

►Flying Tiger Line reports August air freight revenues at \$1,283,145, an 11.5% gain over the same month of 1955. The air freight carrier's eight-month traffic revenues stand at \$9,624,125 for a gain of 54.4% over the same period of last year.

►Frontier Airlines flew 32,900 passengers a total of 3,194,000 passenger miles during August, a 50% gain over the total for August, 1955. During the third quarter period ending Aug. 31, Frontier carried over 90,000 passengers and logged 22,651,000 passenger miles.

►Irish Air Lines flew 110,190 European and transatlantic passengers in August as compared with 95,160 persons during August, 1955. Transatlantic passengers totaled 4,000, and the carrier's Dublin-London route accounted for 55,000 passengers. Dublin Airport reports that it handled 118,168 persons during August as compared with 107,530 handled during the same month of last year.

►Lufthansa German Airlines will add Karachi, Calcutta and Bangkok to its India routes on Nov. 1 and, at the same time, drop Paris, Shannon and New charter. The German carrier says service to the three European cities is being discontinued to better utilize passenger equipment and to prepare for replacing transatlantic Boeing 707-450 turboprop service expected to be inaugurated early in 1960.

►Northwest Airlines was scheduled to begin service to Athens, Greece, on its Chicago-Florida route on a daily basis of twice northbound and three southbound flights.

►Omni Air Lines reports that it carried 50,275 passengers during August, a 35% increase over the same month of last year. During the first eight months of 1956, Omni carried 517,474 passengers by means of a 51,900-hour fleet better for a 20% increase in passenger flown over the same period of last year.

►Trans World Airlines flew 613 million revenue passenger miles on its domestic and international routes during August, a 25% gain over the same month of last year. Domestic revenue passenger miles rose up 23% from August last year at 451,417,800. During the first eight months of 1956, TWA flew a total of 5,814,000,000 revenue passenger miles.



The men:

... USAF aerospace technicians assigned to service the Douglas Green air-to-air nuclear-armed missile. They have undergone extensive training in Air Force technical schools and from Douglas field service engineers to become proficient in both society and nuclear activities.

The mission:

... high-level interception of enemy aircraft. Ideal interception would take place far from U.S. boundaries. The atomic warhead of the Douglas Green was detonated under test conditions over friendly troops with no resultant danger.



Air Force interceptor Jet's "Green" Green aircraft missile.

The missile:

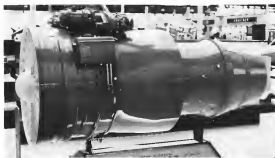
... the Douglas-built Green. This nuclear missile has actually been fired in flight at the Nevada Test Range. Estimatable life allow the missile to rest close to the plane's fuselage, cutting drag. Or it can be carried in the bomb bay. Interceptors can be armed with two Greens.



Depend on

DOUGLAS

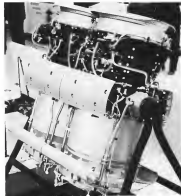
The Nation's Partner in Defense



BRISTOL SIDDELEY RB 55, shown in workshop form, has an inlet diameter of about 4 ft; thrust rating is 14,500 lb.

British Unveil Three Turbine Powerplants

By David A. Anderson



PAISED: Rolls Royce RB 505 engines power Speed Six, SC-1 V10L, research aircraft.

Four-engine—Three gas turbine powerplants were shown for the first time at the 20th Society of British Aircraft Constructors (Viking Display and Exhibition) last but only one was new.

The three Bristol Siddeley RB 55, dubbed for cost and Rolls Royce RB 145, RB 146, and the RB 147. The new engine was the RB 145, one of a family that Bristol Siddeley is developing.

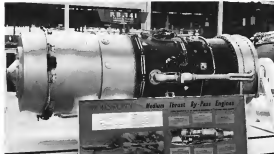
New details were available on some of the engines shown, but it was rather free of Britain's export drive that most of the information on new engines, generally reserved for public presentation during the Four-engine display, had already been issued three months ago in the Press or show.

When walking up "and our British industries." One more market left in the world on sale.

Design Plan

Bristol Siddeley's biggest design is that three families of ducted-fan engines has been designed from the start as that class of engine, and is not merely an adaptation of an existing design. This is a dig at both General Electric, with its allies CJ 601, and Pratt & Whitney with its JT10. Both have developed the General in a bypass engine right from the start, but whether or not it is also a ducted

AERONAUTICAL ENGINEERING



ADGUT shows general outline of the Rolls Royce RB 145 bypass engine. And Aviation has specified this engine at its design rating of 14,500 lb. for an improved Cessna jet trainer. Engine originally was intended for first design of the Avon TWS-121 others had chosen engine the Rolls Royce RB 153, at the same family of bypass power plants but with a thrust rating of 20,000 lb.



BASICALLY an RB 305 development, this RB 145 lightweight turbojet engine is rated at 2,540 lb. thrust. Engine has an afterburner and auxiliary equipment. The company is putting the powerplant in executive aircraft applications.

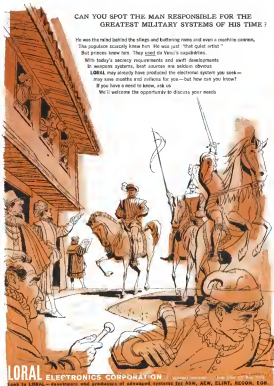
CAN YOU SPOT THE MAN RESPONSIBLE FOR THE GREATEST MILITARY SYSTEMS OF HIS TIME?

He was the mind behind the slings and battering rams and even a machine cannon. The populace scarcely knew him. He was just "that quiet artist." But princes knew him. They used de Vinci's capabilities.

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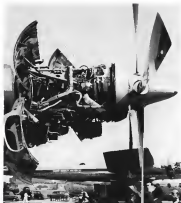
We'll welcome the opportunity to discuss your needs.



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FUTAL engines on Rolls-Royce Trent turbofan engine installation on the Victor Vapour transport open wide for engine inspection and maintenance.

for a simply an apparent crackle in acoustic, not technical, terms.

Both types of engines require some air and bleed some more air around the outside. The Bristol Siddeley diesel free engines operate with a ratio of cold air flow to the turbofan, located at, of between 1.5 to 2.0. Rolls-Royce believes in a lower ratio than that.

Bristol also claims a reduction in noise level of about 10 db compared with the best jet engine, and 15 db below the average engine. Because diesel units are related to the top ratio of the actual noise intensity, a 10 db reduction means the noise is halved.

The BE 51 is a related engine in the same family being used in the power plant of the Harrier-Strike P.1127 VTOL strike fighter. Reports here are that the engine is being supported by NATO Weapons Development Program funds.

Only BE 56 performance figures have been revealed. That of the engine is 14,500 hp, weight is 2,600 lb. Gross specific fuel consumption is 0.5 lb./lb./hr at 36,000 ft and at sea level static the fuel consumption is 0.572 lb./lb./hr.

Thrust weight ratio of the BE 55 is 5.5 to one. Inlet diameter is about four feet.

Bristol showed its Olympus BC12 to the British for the first time. The engine was developed as a second generation strike fighter powerplant under NATO sponsorship. Design thrust is 6,510 lb, increasing to 8,170 lb with simplified afterburning. The engine weighs 1,110 lb, hot and dry, and has a thrust weight ratio of 6.15 to one.

Olympus 201

Great as the Bristol Siddeley stand over the Olympus 201, now rated at 17,600 lb dry thrust. One development of this engine, using a Bristol Siddeley Selsa half variable afterburner, has been run at 11,600 lb thrust. The Olympus 200 series powers the Avon Vulcan B2 bomber and a developed Olympus has been chosen as the power plant for the TSR.2 strike aircraft under great contract to English Electric and Victor.

De Havilland's Gnome II, DQJ 10 (AW Sept '74, p 48) used in the engine for the Bristol 1.150 all-attack supersonic aircraft, now shown with an experimental afterburner. Both

LOOK TO LORAL FOR COUNTERMEASURES



MICROWAVE RECEIVERS AND ANALYZERS



ASW AND AEW DISPLAY SYSTEMS



AIRBORNE NAVIGATIONAL COMPUTERS



AIRBORNE PLOTTERS



GROUND POSITION INDICATORS



LORAL is equipped with specialized manpower and physical resources to undertake the full responsibility of electronic development... has served the Armed Forces directly—and their prime contractors—in the fields of Countermeasures, Weapons Systems, Reconnaissance... and other phases of success.

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PROBLEM:

Measure angular acceleration accurately

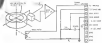
ANSWER:

The New Donner Angular Accelerometer

Light
Compact
High natural frequency

THE FACTS... As you are well aware, designing a good angular accelerometer is a tough technical task. Donner Scientific's new unit is another successful chapter in a record of creative engineering.

Chief applications for the unique force balance angular accelerometer are closing the servo loop on ground landing equipment for missiles and detecting the roll, pitch and yaw oscillations of missiles once they are airborne. In the latter application, the Model 4525 can replace some gyros and supplement others.



Operational diagram of Donner's new Model 4525 Angular Accelerometer

The mechanically rugged and electronically rigid Model 4525 is one more basic technical contribution from an engineering team specializing in inertial systems interlocking time, acceleration, velocity, and other dynamic inputs.

MORE DATA AVAILABLE—An illustrated 4 page data file is yours for the asking. Please address Dept. 050.

DONNER SCIENTIFIC COMPANY
CONCORD, CALIFORNIA

The Specs
RANGE AVAILABLE
From ± 1 mil/sec² to ± 50 mil/sec² to any intermediate range
FREQUENCY RESPONSES
 ± 1 mil/sec² 30 cps natural frequency (30° lag)
 ± 50 mil/sec² 100 cps natural frequency (30° lag)
OUTPUT, FULL SCALE
 ± 50 volts span to 12,500 ohm load
RESOLUTION 0.01% full scale or better
LINEARITY 0.1% full scale
HYSTERESIS Less than 0.01% full scale
DAMPING 0.6 to 0.7 of critical
SIZE 3 1/2" diameter x 3 1/2" high
WEIGHT 2 pounds

Donner's rugged new angular accelerometer weighs only 2 pounds.



One of two RB-47E's that taildrop satellites on the American Whitehall NW 65° Arctic transport down the cooling arrangement designed for satellites.

the engine and the afterburner now are being installed at the National Gas Turbine Establishment for simulated high altitude flight tests. Engine output is 10,000 hp dry thrust and with the afterburner operating at 20,000 lb, static thrust output is approximately 40%.

Overall length of the Grumman is 66 ft 6 in, with a 12 1/2 ft and height is 19 ft 6 in.

Rolls-Royce's newest entry in the field is an engineering modification of the RB 144, out of a group of turbo engines being developed to meet the thrust requirements of the P-10B in the 17,500 lb thrust range of the Conquest. First RB 144 is scheduled to run sometime in October this year. Production engines will be available in

1962 at a thrust rating of 14,300 lb. Also in the family is the RB 163 from the same engine for the Aero DB-121, includes dry, afterburner for 10's. Rated at 10,000 lb, thrust the RB 163 is expected to be available at the end of 1963 for the DB-121.

Newest engine in the Aero line is the RB 144, now in place for the English Electric P-10B, rated at 17,500 lb thrust without afterburner. The power installation of these engines in the P-10B has two built-in variable afterburners. Thrust is determined by bridge wire, because there is not enough room in the rear end of the P-10B to take two afterburners for 20,000 operation.

Available thrust movement is on the order of 25 to 50%, giving a maximum installed thrust of about 14,000 lb.



Viscount 810 Checks Vanguard Tail

Viscon Vanguard transport replaces equipped with Naper Sparrow down is carried by the Viscount 810 in Continental. Low wing mounted in place of the engine at port of Vanguard installation tail. Chief crew TV monitor effect of water spray down of tail.

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Vampire Supermarine Scout with markings of Royal Navy's 807 Squadron, fully in wings after landing—Naval flight display featured ten-landing demonstration with much tactical close weapons, formation aerobics, high speed runs and wings landing.



Blazing across the field like a fighting bull across the ring, the British Electric Lightning T.4 supremely braves the helipad form of air racing over the cockpit. The aircraft is loaded with a two-ton lightning. The tower is carrying two de Havilland Firebrakes (airborne bombing coaches). The stacked tank carries extra fuel. The aircraft also carries a Super Scorpion rocket for boosting performance at altitude. Powerplants are twin Rolls-Royce Avons with afterburners.

British Display Varied Aircraft At Farnborough

Flight demonstrations were the principal attraction of the 30th Society of British Aircraft Constructors Flying Display and Exhibition. The Vampire Supermarine Scout (top left) participated in a landing maneuver in which it and another Scout landed downwind, each lagging the shoulder of the runway. During their landing roll they folded their wings so a third Scout could land upwind between them (NW Sept. 21, p. 32). Ronald Farnham, an actual combat war leader in Farnborough operations, brought the Avon Aget down in a steep approach, making steep dips right and left in the runway and then diving as shown at right, below. The British Electric T.4 (bottom, below) was flown by R. F. Bennett, who made a series of low-level high-g turns. During the landing roll at the conclusion of his performance the drag chute blew out and Bennett was forced to abort all the maneuver to avoid hitting vehicles parked at its end. He came to a stop without damaging the aircraft. Those of the Royal Air Force's Bomber Command Avon Vulcan (right) participated in the flying display. The Avon Vulcan B.2 bomber (top right) is powered by the Bristol Siddeley Olympus 303 turbojet. One version of this engine equipped with a Bristol Siddeley hot-air burner has been static tested at 35,000 lb thrust.



From Bristol Siddeley Olympus engine above the Avon Vulcan B.2 off the ground in a testing climb after a takeoff run on the order of 2,000 ft. Engines are getting out an estimated 25,000 lb. thrust each with afterburning. Airplane is a prototype B.2, production planes have a nose fuselage bulge, probably for increased looking radius.



Ronald Farnham leads the Avon Aget and at its responsive approach after the only simulated aerobics routine at the Farnborough display. Farnham's flight demonstration of the Aget was done in a minimum cube of air, limited competition aerobics and a fast landing that led the Avon Aget down the runway alternately on left and right wheels.



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- heating elements for all types of ground support equipment
- de-icing wires for industrial and commercial refrigeration
- heating blankets for houseboats and marine-motor boating

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New Alloys Shown At Farnborough

Farnborough-New alloys and fabrication techniques of interest to the aircraft industry, presented some of the highlights of the annual exhibition to be given here by the Society of British Aircraft Constructors.

Of special significance was information that the British steel industry, despite limited resources, was taking steps to produce high strength steels with reduced sulfur and phosphorus content.

Research by metal engineers at Rustal Develop, Ltd. has pointed to three two elements as the cause of hot cracking in welded steels.

Magnesium Elektron Ltd. introduced to new, high temperature magnesium alloys. One a strong alloy called MSR, which is being used in various British missiles.

In panel steels, which is available higher than that of existing magnesium alloys is the 0.25% alloy, it is comparable to that of high strength heat-treated aluminum alloys which is 0.2% to 0.4%. In addition to magnesium, the alloy contains 7% vanadium, 2.5% silver and 0.05% zirconium.

The other Magnesium Elektron product is a new wrought alloy named Z1Y which is said to be hot formable, fully weldable and easily machined. It retains its strength constant from 200°C to 1000°C and is virtually resistant to aging. It has up to 900C. Ultimate tensile strength falls off from 14,000 psi to 24,000 psi at 2400°C. Alloying constituents are 0.25% thorium, 0.1% vanadium and 0.05% zirconium.

Inspiral Chemical Industries displayed a new titanium alloy that is now being used in compressor disks and blades of major British jet turbines. Also has an ultimate strength of 104,000 psi at 500°C. In addition to its and zirconium, which are the principal alloying ingredients, nickel creates small amounts of aluminum, molybdenum and silicon.

Park Vickers announced the direct spread of new, temperature low nickel, austenitic stainless steels which are to provide use in solid and turbine fan systems. The new steels contain molybdenum and copper alloy steels.

Mood Nickel Co. Ltd. also demonstrated nickel-base alloys for two new engine steel alloys, one an 80/20 nickel-chrome alloy, the other a 77/23 nickel-chrome alloy with an iron base. Both alloys are alloyed with molybdenum.

Patented steel is available 10% sheet material with economical welding properties at 1,010°C.

Henry Wiggin and Co. Ltd. showed

a new family of wrought steel alloys containing alloys with 12 in diameter ball bearings for turbine disks weighing up to 1,800 lb.

Also shown here were new trends in metal fabrication. Among the new and trending are the ability to construct, in steel, high temperature, high strength, water-tight alloys, some containing tungsten and titanium, and the ability to produce, in steel, high strength, high temperature, water-tight alloys, some containing tungsten and titanium, and the ability to produce, in steel, high strength, high temperature, water-tight alloys, some containing tungsten and titanium.

Use of diffusion bonding and sintered discs, according to the manufacturers, results in better metal alloys.

new with over 40 Buckeye indicators better than \$400 in selling to \$300 in at home. Moreover, multi-colored characteristics are improved. On a type of pressing made in a separate die, 1 to 10 blades centrifugal impeller 1/2 in in diameter. Information on the 0.01-in. thick blades was lost to \$300 in.

The largest example of a vacuum control high temperature, water-tight steel was a 1/2-in. long in a high output alloy.

One of the major reasons for the growing use of vacuum casting is to prevent the oxidation of the titanium and aluminum and in their alloys to improve bonding properties.

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The 60 mesh strainer screen, 1/2" located in the center, is removable by hand. 100 mesh strainer is optional. Replaceable trigger guard comes with a 3-inch loop for hanging. Standard equipment includes dust cap around inlet and aluminum deflector tube. It's the standard to use, standard in work with nozzle over designed.

For full details on this and other Buckeye Aviation Fueling Equipment, write:

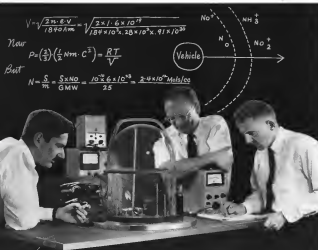
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Exploring the Fringe of Space

The environment at aerospace altitudes* and the special conditions created there by re-entering space vehicles and satellites, are subjects of advanced study in the research laboratories of **Giannini Controls Corporation**. Primary objective: to obtain data and formulate values for conditions in this little known region, and to determine what types of instrumentation will be necessary for accurate measurement and control in this realm of Space Flight. • **Giannini** researchers are making use of the theories of high vacuum technology, plasma physics, ionic processes, electron-optics, and aerodynamics, branches of physics only vaguely considered heretofore by the aerodynamicist. A major tool being developed for this study and to test space-age instrumentation is the Electro-Molecular Instrument Space Simulator (EMISS) shown below in its research stage.

*The region which begins about 75 miles above the earth's surface



Giannini Controls Corporation 315 East Green Street, Pasadena, California

Engineering opportunities now exist at **Giannini** for such as: systems, laboratory personnel by writing to the Director of Engineering.



STEPPING transistor, developed by Bell Laboratories, is knowledge key member links called as a single point of silicon measuring only 0.04 in. in diameter.

physics and scientists, working in the Solid State Division on miniature projects.

- **Giannini Controls Corp.**, Pasadena, is investigating semiconductor transistors on including such devices as photo-conductors, fluorescent glow-tubes and x-ray cathodes.
- **Hales, Inc.**, 71 Segunda Calif., is a newly formed company that specializes in vacuum deposition of thin films of conductive, insulating and semiconducting materials to form integrated circuits.
- **Hughes Aircraft Co.** recently awarded to develop a computer-aided electronics program to integrate efforts of its several laboratories and its Semiconductor Division.

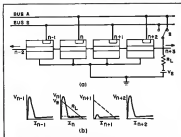
• **International Resistor Corp.**, is working with vacuum dependent techniques in fabricating integrated resistors—capacitors, resistors which act as shields (passives), diodes can be inserted.

• **East** has set up a solid-state physics laboratory in Santa Monica, Calif., to work on the area of photoconductivity, photoemission, storage devices and solid-state memory. A new 540V-100 laboratory facility was completed about 10 professional scientists, a facility expected to double by the end of the year.

• **Eltron Industries** has a semiconductor research facility operating within its Computer Systems Laboratory to investigate vacuum-deposited thin magnetic films for use in computer logic and storage elements. The facility also is experimenting with diffusion doping of boron to produce thyristors. Eltron has licensed a semiconductor device which performs like a 1000 step to provide universal protection.

• **Semiconductors, Inc.**, at its Santa Barbara, Calif., research facility also is working with thin magnetic films, produced by vacuum deposition, for use in high density computer storage elements. The solid film alloy, about 2,000 angstroms thick, has a lifetime of a billion of a half-millionth of a second. The research laboratory also is working on developing new types of ternary compound materials for use in thermoelectric power generation.

• **Nikolova** is investigating both etching and film deposition techniques for fabricating integrated microelectronic circuits, including active and passive elements.



PRINCIPLE of operation of stepping transistor is shown as a three-stage circuit in which the lower equivalent circuit across one stage to the right (next switch) is closed. V_n is illustrated in between show stage "n" in low impedance state.

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When SAC slings a pair of GAIM-77 Horned Dog into ground missiles under the wings of the new B-50D bomber, it has what amounts to a brand new weapon system.

For the Horned Dog's jet engine drives it at supersonic speed to a target hundreds of miles away. Its self-contained inertial extender, not before launch by the B-52's crew, can't be jammed, can't be decoyed.

The GAIM-77 Horned Dog program got underway in August, 1957. The missile is already in its flight test phase. Thanks to accelerated development, it will be deployed by 1960.

SAC's and ARDC's "blue-suit" integration program further speeds the Horned Dog's operational status. As every other test missile comes off the production line, half the crew assigned to it is from the Air Force.

The Missile Division of North American Aviation is weapon system contractor for the GAIM-77 Horned Dog.

MISSILE DIVISION
NORTH AMERICAN AVIATION, INC., DONNEY, CALIFORNIA



COMPLETE light computer adds input, work a compact element of 194-090 per square foot, is constructed by Agave using 8.5 x 8.5 x 8.03 in. ceramic substrates upon which resistors, capacitors and semiconductor have been deposited (dollar). Contract box resembles RCA Micro-Module



not elements. The company predicts its work will soon make possible component densities of "one of millions" per cubic foot.

In addition to the foregoing, there is the RCA-Avian Micro-Module program (AW April 14, p. 75) and the Avian Diamond Ordnance Fuse Laboratory micro-circuit program (AW June 16, 1958, p. 245).

Shipping Transistor

Unique fractional equivalent of a series of flip-flop circuits in the form of a four-stage ring counter. Fabricated on a single silicon crystal measuring only 0.040 in. in diameter, was reported by L. A. D'Amico of Bell Telephone Laboratories, Murray Hill, N. J. during Western

Each stage in the ring counter consists of a P-N-P-N transistor which operates in a bi-stable element without any external excitation or excitation. The device can operate at frequencies as high as 1 mc, and even higher speed ring rates may be possible with future developments. (D'Amico indicated) The device can be designed to operate in

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Among the most severe environments that Avco now faces most rigorous are the re-entry problems of mechanical and acoustic noise vibration, extremely high temperature and deceleration shocks. These environmental problems will be common to all space vehicles.

Typical example of testing machines is the Avco-developed acoustic noise generator which creates the extremely high noise level that occurs during atmospheric re-entry.

Profiling, preflight, and solving new environmental problems is an interesting, challenging job for Avco engineers and scientists, but it is only one of the many fields of work at Avco. Basic research and advanced development are carried on over an extremely wide area, making many scientific disciplines and creating an interchange of information and a stimulating work atmosphere.

For info on an unusual career opportunity, for employment consideration and engineers, write to: E. R. Brown, Scientific and Technical Relations Area Research and Advanced Development Division, Avco Corporation, 331 Lowell Street, Wilmington, Mass.



SPUTTERED circuit, which uses insulation film for resistor, capacitor and conductor films, permits with thick metal elements can be fabricated using copper masking. Lines 0.02 in. wide, with 0.02 in. spacing were achieved by Bell Laboratories.

supply voltage of 10 to 900 v. Current gain per stage is greater than unity and can run as high as 100, he reported.

D'Amico pointed out that the new stripping transistor resembles the gas discharge stripping tube in its operation, with one important difference. Whereas the transfer of a pulse from one electrode to another in the gas tube requires physical proximity between the electrodes, each stage of a stripping transistor can be packaged separately, if desired, with only an electrical connection between stages. If several stages are fabricated on a single crystal, the transfer from one stage to the next is accomplished by means of minority carriers from the P-N junction which is common to all stages. Nonreciprocal operation in transistor configuration is used to establish the desired direction of transfer.

Transistor Circuitry

Bell Telephone Laboratories has fabricated complete passive circuits, including resistors, capacitors and inductors, achieved from a single metal-insulator using a variation of the vacuum deposition process which is known as "sputtering."

One three-stage flip-flop fabricated in this process contained 24 sections with resistors up to 121,000 ohms, wire capacitors with values of 0.01 mfd., and plug-in holes for an inductor and one diode on a square board measuring only 2 x 2 x 0.05 in., to give a passive component density of 775,000 per cubic foot, according to D. A. McLean of Bell Telephone Laboratories.

McLean told Wires that considerably higher packaging densities appear possible. For example, by using both sides of the current metal-insulator composite, he could be easily doubled. If multiple layer film were employed,

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smaller,
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9 Push-pull coupling	Flexible, fast, no design, no service charges, no pull time	
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13 Accuracy	Microfilm, suitable for 200-300 pull, no pull	

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The needs of the Bell Telephone Laboratories approach to the use of transition metal complexes as promoters of the anion is discussed. The complexes are followed by depositing a thin transition film, annealing it, then depositing a semiconducting dielectric of choice. During this process the films have followed several steps: a capacitance of about 2.1 nF per square centimeter by operation at 70 volts. These have no transition resistance at about 7000 to 5,000 ohm-cm-farads at 75 volts with dielectric factors of 10 or less. Maximum required Temperature coefficient is about 240 ppm per degree centigrade. Dielectric constant of the dielectric material used is approximately 15.

Tentative Film

Treatable films react with oxygen to form a thin surface layer of oxide, thus allowing resistance to change. For this reason, it is essential to evaluate treatable film resins with a heat treatment in air. McLane and Chase (10) have done this; the resins prove quite stable. In repeated tests on BVL laboratory samples, indicate an average change in coefficient of only about 0.2% after 500 hr of exposure at 100°C. Resistances of up to 500 ohms per square have been obtained with treatable films. McLane (11) reviewed

The sputtering technique for thin film deposition is used instead of the conventional evaporative deposition process on boronate thinfilms does not convert at the low temperatures of sputter coating. In the sputtering process, the vacuum chamber is filled with some gases and a high voltage is then applied between the tinplate cathode and a tungsten anode to which is attached the substrate upon which the film is to be deposited. The target gases are then ionized and the tinplate cathode is the high potential. As these positive ions strike the cathode, they knock off electrons, which are attracted to the substrate and deposited there.

Tantalum then is sputtered over the whole surface and it is again measured.



STRATEGIC TARGETS Like the one shown below, are powered by one diffuse valve, one small muscle and three sensory receptors. Counting all these systems as a critical role of Sperry-designed computers.



Spreading Confusion

Out of a growing bag of electronic tricks, Sperry engineers are creating new and better ways to mislead potential enemies.

THE STORY BEHIND THE STORY
of Eastern Christianity and the Bible

While every effort is being made to make America's radar defense more effective, equal effort is being made by a group of Sperry engineers to make radar defense less effective — if the defenses are those of a possible enemy.

In World War II tool called "chaff" dropped from Allied planes cluttered enemy radarscopes—made it difficult to use for attackers. Then came "jammer."

The Sperry Commandment System designed for use aboard USAF's Boeing B-1B's represents a revolutionary advance in defense technology. The system is a different paradigm of the enemy, which greatly enhances the success of the strategic bombing mission and creates protection for plane and crew in addition to its work with the B-1B.

program, the Sperry device is also devoted to finding ways of countering every new advance in offensive weapons with even more effective defensive confusion systems. Countermasures Division, Sperry Gyroscope Company, Division of Sperry Rand Corporation, Great Neck, New York.

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is as evident. The copper and overlying hardware are now etched away leaving barelines only where the substrate had been covered by the previous photo-etch process. If additional treatment can be applied to copper wire, this can be done by using masks, after which these areas are soldered with wire or electrodeposited tape and insulation, McLean said.

Through the use of the reproducible copper coating technique, it is possible to get extremely fine detail, linear and conducting lines which measure only 0.001 in. wide with 0.001 in. spacing between lines has been achieved. With additional development, these figures can be further reduced, McLean suggested.

McLean and the Bell Telephone Laboratories is now working on "one particle atomic elements" (transistors) devices, but he declined to elaborate.

Dynamic testing of the remaining characteristics of a flying circuit while it is being fabricated by vacuum deposition process was described by W. D. Teller of Lockheed's Missile and Space Division (Palo Alto) which was completed by Vaco Manufacturing Co. Teller told Wessons that Lockheed observes the most steps of the circuit during the process of depositing resistive material to determine when the process should be terminated.

Teller described several deposited flip-flop circuit configurations with extremely high packaging densities. One achieved density of 50 million power components per cubic foot, Teller said.

Arma Program

Edward Keegan of American Bosch Arma Corp. told Wessons about his company's micro-communication program which calls for the construction of a space vehicle guidance computer by 1961-62 which will be only 1/10 in. long and heavy as present designs using conventional construction techniques. Arma has selected an adiabatic circuit from its Adia inertial guidance circuit as a test case to see how much it can be made to be squeezed down. The adiabatic consists of eight "And" circuits, sense amplifiers and one flip-flop.

Working with half a dozen conventional microstructures, Arma has constructed an adiabatic consisting of a stack of constant values measuring 0.5 x 0.5 x 0.03 in. upon which are printed its action, miniature capacitors and areas encapsulated silicon transistors and diodes. The stack of wafers is interconnected by means of external bus bars, giving it a modular appearance to the Macro Module being developed by RCA for the Arma, except that the latter employs auxiliary wiring.

The Arma adiabatic occupies a volume of about 0.5 cu. in. and delivers a

RADOP GOES SUPERSONIC

New Weapons Training System for Century Series Fighters

Now, for the first time, operational Century Series fighter squadrons can support their own weapons training missions with a supersonic weapons training system. The new Del Mar RADOP (radio/opsonic) system features a gasless-boost, Mach 1.5 target and a unique combination red-launcher.

The supersonic target provides radar reflectivity and related characteristics of multi-pit boresight and constant positions for visual tracking at extreme ranges and high altitudes. The combination red-launcher mounts on a single pylon and the launcher and target rotate from a horizontal to a down position for towing.

These new Model DF-5MPC targets and Model DXL-6A red-launchers are already in production and will soon be in service with operational Air Force squadrons... as the north in a line of advanced weapons training systems from Del Mar.



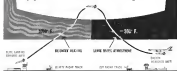
For further information on this or other Del Mar weapons training systems in use by the U.S. Air Force, U.S. Navy and NATO units, write to Dept. AW-1110.

ENGINEERING - DEVELOPMENT - EMPLOYMENT - IMPROVEMENT with the steadily growing organization

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SIX Pacific
CABLE TENSION REGULATORS
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HYPERSONIC SPEEDS THAT CAUSE SURFACE HEATS IN EXCESS OF 1000°F IN DISCARDS, AND 10X TEMPERATURES THAT DROP INITIAL TO LOWS OF -300°F CREATE A SERIES OF DIFFERENTIAL EXPANSION PROBLEMS ON THE CABLE CONTROL SYSTEMS OF NORTH ATLANTIC T-3M.

To solve this problem, in Pacific while lesson regulation was carried on the Speed train, Keaton, Puller, Fitch, Bell and Yocum carried lessons.

These mechanical drivers suggestively and positively compensate for variations in the cable spools—as readily as clutches occur. All control cables are kept at an even tension thereby con-

Specific examples of the potential mapping cables at a lower level show increasing control sensitivity. They are self-contained mechanical devices with a high degree of reliability—and without dependence upon any external power source.

For more information on C&H Control Systems, contact Pacific Scientific Control.

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component density of about 100,000 per cubic foot, Kozsars said. To protect the microconductor designs, the entire module would be sealed in an airtight container.

Next phase of the Arma program is to redesign its computer logic for optimum micromanufacturing, with the objective of minimizing the number of different circuits required.

With further effort, Krasner believes the Ames module approach could compound densities of around 100,000 per cubic foot. He cautions that solid-state memory probably is the more promising approach for the more distant future, not only because of smaller size and weight, but because of its potentially greater reliability due to the fewer number of separate components and soldered interconnections.

During the recent Aero-Navy Transportation Program (ANIP) symposium in Dallas, Tex., (AW Sept 14, p. 18) Vaco Manufacturing displayed some of its latest micro-machined devices, with compound diameters ranging from 1.5 to 10 million per cubic foot. One such device was a fine FMG valve transmitter, powered by micro-machined batteries and using a bearing as a microphone.

The bulk of the effort in micro-instruments is being expended by equipment manufacturers rather than by component manufacturers. Notable exceptions are Trucon Instruments (which is both an equipment and component producer) and International Brainerd Corp. It is true that a number of component makers are responding to the JCA/Anso Micro-Models program, but aside from the extent of making their greater components in a size and

The state of the art in mechatronics appears to be at about the same point as the transistor was 18 years ago, about a year after it had been invented by Bell Telephone Laboratories. The next several years will see the development of a number of useful mechatronics devices which can be used with more conventional circuits or with micro-circuits in many instances.

It probably will be 1962 before a subsystem of modest complexity, such as a digital computer constructed entirely with monolithic devices, will be in operation, and that will be an expensive model.

By 1987, observers expect that digital computers constructed by microelectronic techniques will begin to come into vogue. Digital computers probably will be the first complex equipment to use microelectronic technology because of the major size, weight and power reductions and because such computers are built up from a few types of basic components.

By 1973, however, believe that



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In the power design of the General Electric J79 engine that powers the USAF Lockheed F-304, early consultation with Fluorchem's design engineers resulted in appreciable time and money savings.

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CONTROLLED ENVIRONMENTS - PASSPORT TO SPACE

Soon, the X-15 rocket powered research vehicle, built by North American Aviation, Inc., will carry the first men into space. During this historic flight, many of the instruments installed in the X-15 will be protected against vibration and shock by Robinson mounting systems.

Robinson Model K71D-14, all-metal mount, will protect 20 pressure transmitters connected with the rocket engine chamber, hydraulic fluid system, and the liquid oxygen, helium and ammonia supplies. Other Robinson mountings have been specified for the radio equipment and several other applications.

RADIAL MOUNTING SYSTEMS - THE ULTIMATE IN CENTER-OF-GRAVITY SUSPENSION

Model K71D-14 combines Robinson's MET-L-FLEX stainless steel resilient elements with an exclusive radial cushion, center-of-gravity design. The multi-directional isolation which results ensures complete protection in the high intensity environments created by initial propulsion blast and re-entry.

During extensive development testing on the X-15 program, it was determined that vital instruments must be protected against vibration and shock to insure the calibration and accuracy required. Installation of Robinson mounting systems on the X-15 meets this requirement.

INDUSTRY-WIDE ACCEPTANCE

Twenty-three years of experience, plus unsurpassed craftsmanship, make Robinson the choice of leading defense manufacturers and weapon systems managers. These companies know that their equipment performs better and lasts longer when protected by mounting systems which have been engineered for reliability—by Robinson.



MODEL K71D-14

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aircraft system designers will have a wide range of choice in fixtures which can be performed by Robinson's design.

The situation will be responsible to the state of the transistor art today. Currently there are a sufficient number of different types of transistors on the market to enable the designer to fully transistimize his equipment in nearly all, but not every, application.

One major hurdle to widespread use of solid-state electronics is evidenced as its proponents glowingly describe its potential for improving reliability. It is finding the number of components and soldered connections required.

Manufacturing Problems

Here is the view of an official of a major semiconductor manufacturer as given in "Aviation" who knows the different problems of producing in quantity an extremely reliable device in miniature, and obtaining an economical yield, shoulder in the problems involved in manufacturing in quantity a complex circuit which in effect contains dozens or hundreds of semiconductor junctions—and obtaining an economical yield.

Yet the demand for semiconductor devices has forced manufacturers to mechanize increasingly the fabrication of the device and this has forced them to dig more deeply into the basic areas of low yield. This is increasing much of the "black magic" that has long surrounded the fabrication of semiconductor devices.

It is therefore apparent likely that when the research activities have developed the new functional semiconductor devices, the state of the manufacturing art will have developed sufficiently to meet the challenge of producing these.

Liton Industries Opens Electronics Facility

Liton Industries has formally opened a new plant housing its Electronic Engineering Division, 640 San Fernando Valley, just off Century Los Angeles. Located in Crenshaw Park, the facility is under the direction of Dr. Norman Engstrom.

Liton's efforts announced that work on solid state circuits is being conducted by the Electronic Engineering Division, including aerial navigation, non-mechanical radiofrequency speed circuit research, data processing for tactical systems, digital and analog computer systems.

Division has five departments: Advanced Systems Engineering Department, Guidance Systems Laboratory, Computer and Control Laboratory, Tactical Systems Laboratory and Space Research Laboratory.

Safety Pin Problem?



Bendix-Pacific—fastest manufacturer of mechanical positioning actuators—offers 15 years experience in mechanical locking electrical circuits to help solve today's requirements for maximum reliability and simplicity in Safe Arm mechanisms.

The Bendix-Pacific Shock Release Safety Pin Actuator releases loads events 75 pounds breakaway force and moves 1.5 inches within three seconds. Positively locked in each position. Weight 1.5 pounds.



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Republic F-105—One Depends Upon

Plane "Bomber Formation" Holley for Fuel Control

World's most powerful one man airplane, is reported to carry "as much destructive power as an entire big bomber formation of World War II." Capable of carrying an atomic bomb, the exciting Republic "Thunderchief" gets more than 25,000 pounds of thrust from its Pratt & Whitney Aircraft J75 jet engine with afterburner.

Holley designed, engineered and manufactures the main fuel control, bleed governor and actuator for the J75 engine which has both military and commercial applications. The Holley R-95 control combines "small package" design with light weight and exceptional performance reliability. It's another important reason why more and more engine and air frame manufacturers are turning to Holley for engine components.



New Wings for the Eagle!

World War II's famed Eagle Squadron, now the 301st Squadron of EAC's Fourth Fighter Wing will soon be flying the F-105 Eagle fighter.

The impressive array of the power shows why the Republic F-105 superseded jet is often called the "last man warbird."



The R-95 is the military version of Holley designed and engineered fuel controls made for the J75 jet engine.

Both the Holley R-95 and previous bleed governor and its companion, the bleed valve regulator (shown), are designed and manufactured for the J75 engine.



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AIR 11955 E. NINE MILE ROAD
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Leader in the Design, Development and Manufacture of
Aircraft Fuel Metering Devices



BMWS surveillance radar antenna, one of four recently completed in Greenland. Building (center) houses radar transmitter/receiver.

ICBM Detection Antennas Completed at Thule



Construction of four surveillance radar antennas for Air Force's Ballistic Missile Early Warning System (BMEWS) near Thule, Greenland, has been completed ahead of schedule and installation of radar transmitter/receiver equipment now is under way. The four surveillance antennas, each measuring approximately 400 ft. wide and 365 ft. high, are the largest ever constructed by the United States, possibly the largest in the world. Antennas were designed and built by D. S. Kennedy & Co., under subcontract to General Electric which is developing and manufacturing the surveillance radar. Radio Corporation of America is prime contractor on BMEWS. Each of the four antennas will cover a 90-deg. radar azimuth sector, providing a total of 120 deg. azimuth coverage. Radars, with peak power of approximately 15 mw., are expected to have a range of 3,000 to 3,500 mi. against enemy ballistic missiles. A "pop radar" (not now installed in receiver building as front of each antenna (which also houses radar transmitter/receiver) will produce a split (dual) vertical beam which will scan rapidly in azimuth. Dual vertical beams will make it possible to establish azimuth approximately azimuth and speed, for use in tracking breakers in air. Antennas will provide a radar beam that is approximately one degree in width (AW July 15, 1956, p. 19). Each of the antennas weigh approximately 1,500 tons.



Each four-deployed surveillance antenna, designed and built by D. S. Kennedy & Co., weighs nearly 1,500 tons. Construction was completed in two months—several months ahead of schedule. Antenna structure will be covered with a mesh screen to reflect radar signals. Surveillance radars are expected to have detection range of 2,000 to 3,000 mi. against enemy ballistic missiles. Radio Corporation of America is prime contractor on BMEWS, and General Electric is building the surveillance radar transmitter and receiver.



Convair

880

exceeds performance specs

General Electric's CJ-805 jetliner engine shines in an outstanding aviation achievement: in flight tests the CJ-805 powered Convair 880 has not only bettered all performance guarantees, it has met or bettered even drawing board estimates for speed, range and short distances required for take-off and landing. For airlines and their passengers, these flight test results demonstrate how the 880 will go more places and provide the world's fastest, most versatile air transportation. Powered by dependable General Electric CJ-805 turbojets, the Convair 880 will be years ahead for years to come.



TAKE-OFF less than 5,450 ft.

Flight tests have proved that the 880 can lift off before reaching the 5,450-foot mark* originally estimated. Flight experience indicates that actual runway length needed for take-off may prove to be as much as 8% less. CJ-805 performance has been outstanding throughout Convair's continuing test program. Surpassing the record was thorough G-E flight and ground testing which provided information for engine improvements prior to 880 testing. Extensive flight and ground testing continue. *Same level standard conditions—approx. 1,000-feet (300 ft.)

Outstanding CJ-805-2 performance has helped the Convair 880 exceed performance guarantees for speed, range and short distances required for take-off and landing.

SPEED 615 mph

Four CJ-805 turbojets have provided power for Convair 880 cruise at true air speeds of 625 mph—above guarantees and faster than any other commercial passenger plane in the world. Six months of minimum flight testing have proved speed 605 mph flights have been powered routinely by CJ-805 engines equipped with reversers and suppressors, decreasing maximum thrust losses. Engine, thrust, reverser and sound suppressors have been produced and tested together by G-E, so their performance is especially well matched.

RANGE 3,450 miles

Engineering estimates of the 880's range and fuel economies have been confirmed by data accumulated during 150 hours (about 120 flights). Flows for best economy, the 880 will range 3,450 miles. Excellent CJ-805 SFC's make an especially important contribution. The 880 was designed and built to operate from short grassy-air airports. Proved range makes the 880 even more versatile by permitting non-stop jet 880 service between metropolitan centers as well as on shorter routes. The 880 can go more places.

LANDING less than 5,350 ft.

880 landing tests show that the estimated 5,350 foot landing distance may be considerably shortened. In tests, only aircraft brakes were used. Thrust reversers, which provide reverse thrust equal to 46% of forward thrust, not only landing distance even further. Short take-off and landing is another reason the 880 can go more places. The CJ-805, which helps make 880 performance outstanding, is the result of knowledge and experience gained in more than 12 million G-E jet flight hours. General Electric Company, Cincinnati 15, Ohio 45210



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The Navy's Versatile Vigilante

... an all weather attack weapon system with unlimited talents for limited war

Versatility means the ability to do several things well—but frequently not to excel in any one of them.

Not so with the Navy's new AS5 Vigilante. It can perform a wide variety of missions—yet its sharply increased performance in each would justify building it as a single-purpose airplane.

This is the kind of versatility that handles the harsh cast of today's 75-percent-electronic weapon systems... provides the right muscle for every mission... turns autonomous business into mission air power.

With Vigilante ahead in its career, the Navy will have

glide-engaging power in control limited war—from breakfast to bedtime.

For the Vigilante will deliver any weapon—bomb or missile, conventional or nuclear—day or night, in any weather, at any altitude, from any altitude, a full thousand miles from its carrier. No target can hide from its eagle eye. It can be used as a sniper in limited war... as a Mad Max in all-out conflict.

The Vigilante is now in flight in a role that for the Navy Dangler and her brother the Columbus Division of North American Aviation.

THE COLUMBUS DIVISION OF NORTH AMERICAN AVIATION, INC.

Columbus, OH 43060



U.S. Traffic Control To Cost \$1 Billion

New York—Federal Aviation Agency funding for air traffic control facilities for the next several years will average between \$150 and \$200 million, bringing the total U.S. investment in air traffic control and navigation to about \$1 billion by 1982, according to Joseph H. Tipton, FAA's acting director of facilities, speaking at PAA's announcement of the air traffic control study begun earlier in the New York area.

Tipton said that the immediate goal of FAA is to bring air traffic control facilities to the point where as a nationwide basis, all traffic above 15,000 ft will be under radar and become surveillance as control, plus additional radar and beacon coverage of mobile instrument altitudes on all major airports and through the cooperative integration of civil and military terminals radar beacon systems.

The radar beacon system placed in operation at the New York Air Route Traffic Control Center (NATCC) May 4, p. 126 includes installation of beacon interrogators and receivers, with de-fueling equipment to inject system replies, at three New York facilities.

- Keesler tower air route surveillance radar.
- New York air route traffic control center terminal area radar.
- La Guardia tower airport surveillance radar.
- Newark tower airport surveillance radar.

The FAA plans that eventually all airport surveillance radar, terminal area radar, and air route radar will be equipped with radar beacon systems. Scheduled to be placed in operation this year are terminal at Los Angeles Traffic Control Center in Washington, New York, Pittsburgh, Boston, Indianapolis, Miami, Atlanta, Memphis, St. Louis, Los Angeles, Seattle, Salt Lake City, and Denver.

- Boston: 1,414 transmitters, plus 27,040 for ground control and launch equipment.
- Phoenix: 1,430 transmitters, plus 20,991 for guidance control and launch.
- E-12: 10,903 transmitters.
- F-1050/E: 1,299 transmitters.
- Navy Terminal Data System: 30,764 transmitters.

What's in a Name?—Insider report that Lockheed Aircraft is particularly grateful that American West, called the "new" "insider" name for a decade ago company, whose slogan is "Look to Lockheed for Leadership," recently named its new operations Lockheed

Decorators & Avionics Division, whose initials spell LEAD. Without the word aviation it would have spelled LED.

USAF Fishes for New Warning Techniques—In search for new detection techniques, Air Force is sponsoring a study of the ability of the tropical lank fish and electric eel to detect the presence of other fish and discriminate between friend and foe by currents produced in the electric field set up by the lank fish and eel, according to Dr. Eleanor E. Snavely, chief biologist for Air Force Office of Scientific Research. At recent symposium on Cooperative



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This 4 x 6 inch size unit will drive even larger loads than any other welder of its class because—

- Its new transducer (Miller designed and built) has integral flux divider.
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These features contribute to the Gold Star SR's greater arc stability, greater speed, easy arc starting and flexibility to handle all electrodes in all positions.

Performance proved wherever profits are important: the Gold Star SR is available in single and duplex models at 200 to 1200 amperes at 60% duty cycle ratings.



GOLD STAR

All-Weather
SRH



The features that set the SR apart and beyond the normal standards of water generators belong to the SRH size that is addition to the increased design for water storage and control. In this water tank in all weather construction that includes heated storage in the exterior, and readily plus plugging and patching of all size and sheet metal—most two plates. Can't get enough? We'll send you more.

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THE FLYING SUBMARINE

"Flying Submarine" describes AMPHENOL's new **amcof** 67 series connector, it may seem a large and unlikely name to fasten on such a small connector, but it's quite accurate. Here's why: The performance characteristics under which these accurate "F" connectors will operate entirely are exactly like those experienced by a submerged submarine—flying at 60,000 feet altitude.

"Flying Submarine" also means altitude-measure instrument. Under a test scenario devised by industry and the armed services, wired **amcof** connectors are completely submerged in salt water, altitude cycled to 60,000 feet for one minute, 65,000 feet for one half hour and then returned to ambient pressure for another half hour. Following this test, the minimum insulation resistance of **amcof** connectors is 1,000 megohms, well in excess of the 500 megohms required by MIL-C-3003 after moisture exposure.

What can a "Flying Submarine" do for you? If you use electrical connectors in aircraft, missile or naval applications (including non-flying vehicles), **amcof** connectors provide assured environmental performance in service at sea level and at high altitudes. Write for complete information on AMPHENOL's **amcof** connectors!

AMPHENOL's Authorized Industrial Distributors stock AMPHENOL and other standard AMPHENOL components and provide on-the-spot delivery.



connector division

AMPHENOL-BORG ELECTRONICS CORPORATION
Cherry Hill, NJ 08002



Thermionic MicroModules

Your TMM-50 (thermionic integrated Micro Modules) modules contain vacuum tubes with built-in control elements have been constructed by General Electric in four different sizes. From left to right, a double cathode diode; a diode, two triodes, four triodes and two cathodes; a triode, four triodes and one cathode; a multielement logic module with eight diodes and three triodes; and a multielement containing two triodes, two diodes and one cathode. AMPHENOL has a component density of 250,000 per cubic foot. Device has been operated at temperatures as high as 500°C, and operates in vacuum levels.

Electronics in Rio de Janeiro Dr. M. W. Lannan of Cambridge University said that fish and eels migrate using the surface of other objects by their varying electrical conductivity. Dr. Lannan believes the changes in electric field are detected by the eels. The skin of the fish or eel that lead through cracks filled with a gel-like substance to glasslike sea geyers, called "micro-movements," which in turn connect to the brain.

■ **Missile Detection Radar**—Both Hughes Aircraft and Bendix Radio are marketing new radar-missile tech reports for detection and tracking of ballistic missiles.

■ **Signed on Dotted Line**—Major contract awards recently announced by aircraft manufacturers include:

■ **Coltair Radar** expects orders for \$1 million from Lockheed for communications and navigation equipment to be used on Lockheed Jetstar business aircraft. First 25 aircraft will use Coltair equipment throughout, including integrated flight system, four 5125 VHF services, two 11L7 VHF transmitter, two DP-702 automatic direction finders, two 51-V phase shifter receiver, a 5125-3 starter beacon receiver and associated receiver systems with an ATC transponder and antennas for all equipment. Deliveries will begin in October.

■ **International Rectifier Corp.**, El Segundo, Calif., \$150,000 in contract from Lockheed Martin and Westinghouse for silicon solar cells and panels.

FINANCIAL

Insurance Funds Go To General Dynamics

New York—General Dynamics Corp. closed out a major long-term financing program with the sale of \$60 million of 10-year promissory notes to the Prudential Insurance Co. of America in the face of a tightening money market.

A similar loan involving \$75 million completed a year ago provides the corporation with \$195 million in long-term money. Combined with its short-term bank credit available of \$175 million, the funds will raise General Dynamics capital needs for the foreseeable future, Board Chairman Frank Pace said.

The financing adds another notch in a steadily growing total of \$1 billion industry companies which have successfully obtained funds from the relatively small amount of insurance company capital directed to industrial sources (AW May 15, p. 31).

Interest rate on the new funds is 5 1/2%. It was set at 5 1/2% in the first borrowing. With prime bank short-term interest rates now at 5% (AW Sept. 14, p. 37), the long-term rates are considered very favorable by company. No comment said, duration is crafted as in the case of many recent public bond offerings to insure companies and an underwriting expense was necessary.

The funds are needed for such development projects as the Cosmos 180 and 608 jet transports, the Convair GL-4 turboprop transport and the C-141 Hercules involved in such situations as the transfer of American Airlines' DC-77 passenger aircraft to its order for Conquest 680.

New acquisitions which require straight cash outlays also will draw on the financing as will opportunities for new business gained by scientific research and development carried on by the company.

New Offerings

Radiant Lamp & Electronics Corp., Kennerly, N. J., a newly organized company, offering is \$250,000 of five 10-year convertible debentures and 125,000 shares of Class A common stock at \$5 per share; it is to be made by Ames Trust & Co., Inc., underwriting group, for the purpose of acquiring the assets and rights of the assets of Radiant Lamp Corp., Newark, N. J., manufacturer of special purpose electronic lamps. Purchase price is \$1,000,000, with \$600,000 payable in cash at the closing, and \$400,000 payable at

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- in minutes • without error • in sharp detail

Now you can hook the time (transmit) phase or cost-to-own (if necessary) of any kind of visual data to volume. With a Fairchild facsimile communication system, planned to serve your specific needs, you can transmit engineering drawings, change orders, blueprints, charts, sketches, memos, schedules, specifications, photos, contracts, notices, shipping orders, forms, letters. You can use short wave radio, telephone, leased wire or microwave transmission. You can transmit data rapidly and dependably, without error, and with the sharpest detail available today.

Aircraft industry applications

Northrop Aircraft, for example, uses Fairchild Facsimile to save valuable time in transmitting engineering data between Hawthorne, Calif., and Cape Canaveral, Douglas Aircraft in Fort 3 way communication between Santa Monica, Long Beach and Edwards Air

Force Base in California, finds Fairchild Facsimile's extreme clarity of special service. Often, an receiving through order facilities, an engineer will make plans for various phases and resources that in another phase.

Nationwide service

Operational? Just attach the copy, set the amount, press a button, and in less than 5 minutes transmission is complete at the receiving end (reliability). It has served the demanding needs of the newspaper industry for over 20 years. Service? Fairchild offers an established nationwide organization, unaffiliated in the field, that includes 30 experienced service specialists. Cost? An attractive lease management offers preventive maintenance, periodic equipment updating, and replacement systems as required models are developed. For full information, and coupon use for brochure "To Deliver the Facts... Fast."



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Deadly darting missiles and super-sonic fighters now prove in flight the advantages of Brunswick leadership in critical aerospace components. Brunswick designs, tests and manufactures reinforced plastic and filament-wound super-sonic radomes to meet most environmental needs.

Critical Brunswick components are now specified and/or used in missiles such as the McDonnell Quail, Lockheed Kingfisher and Pegasus, and Boeing Bomarc; in aircraft such as the Convair F-106A and B-54, North American F-108, McDonnell F3H, F4H and F-101, and Republic F-105.

From filament-wound radomes by the unique Strickland II Process to honeycomb-core, foam-in-place or semi-rigid type radomes, Brunswick supplies the reliability of proven leadership. Write to Brunswick-Ballou-Colleswider Co., Defense Products Division, 1700 Messier St., Muskegon, Michigan.

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the closing price of shares, at \$40,000 of 5% debentures to be used by the new company. As part of the agreement, the new company will be permitted to accept the preference now owned and accepted by the seller, pursuant to a 10-year lease at a rental of \$70,000 per year, plus certain expenses.

Chenier Vought Aircraft, Inc., Dallas, Tex., 27,354 shares of common stock, for insurance upon the extreme of options granted or to be granted under the company's Employee Stock Option Plan.

Rothstein Dressman, Inc., Worcester, N. Y., engaged in the development, production, construction and sale of model of Dornierbom, a high energy aircraft. Offering in 25,000 shares of common stock. Subject to subscription of 20 the shares being offered to stockholders. Dornierbom & Co has agreed to purchase 1,400 shares for its own account and to place 11,171 shares with selected investors at \$10 per share, with warrants to purchase an equal number of shares at \$17.50.

Wickham Electrical Instrument Co., Cleveland, Ohio, manufacturer of electrical measuring meters, electronic laboratory and service testing instruments, and other electronic equipment. Offering in 5,000,000 of convertible debentures and 100,000 shares of Class A common capital stock. 80,000 shares to be offered to the public and 10,000 shares to employees. Proceeds will be used to retire bank loans, to construct and equip research and development laboratories, for additional equipment for a subsidiary, for research improvements, etc., with the balance to be added to working capital.

Financial Briefs

• **Throm, Inc.** Co. raised \$105,195 and repaid debt of \$1,111,143 in the six months ended Feb. 31. Of the net \$200,000 was from sale of 4,500 shares of Throm Electronics Co. preferred stock issued in Throm. The net from stock sale for the same period, the profit was \$45,000 on sales of \$4,000. Throm has progressed from a net operating loss of \$461,800 in Fiscal 1965 and a net working capital deficit of \$493,900 to the profit side of the balance and total retained capital of \$1,052,000 as of Feb. 31.

• **Marquardt Corp.** will reach \$70 million in 1969 and its earnings \$18 million, the company president, Ray E. Marquardt, forecasts. Management is working on high-energy fuel a program which will continue despite cancellation of military launch programs.

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Spadock pointed on Radioplane XQ-4 drone show fire structures from being destroyed.



Radioplane Drone Recovered After Direct Hit

Radioplane Radioplane XQ-4 drone was recovered successfully (below) after a direct hit by a Sparrow anti-air missile after the drone was introduced in a Boeing B-59 bomber. XQ-4 is powered by a Westinghouse XJ35-WE-3 turbojet engine producing 3,740 lb. thrust; production Q48 drone will be powered by a General Electric J85 turbojet which develops 1,850 lb. thrust with afterburner. Radioplane recovery personnel is located in the tail cone, vertical stabilizer section during recovery.



and on a multi-engine configuration engine (AW Aug. 10, p. 14).

• **Donnas Helicopters, Inc.** agreed to a consent agreement in connection with Securities and Exchange Commission compliance on the issuance of common stock of the company, largely to comply in payment for services, without registration under terms of the Securities Act of 1933. The SEC and \$50,000 shares had been issued since Jan. 1 to 125 persons. Insurance stock would have required registration, the SEC said, but the situation was further complicated by the sale of the stock, quoted in the National Daily Question Sheets at prices from 2 to 14.

• **Kanaw Aircraft Corp.** reported first half sales increased from \$8,415,873 to \$14,796,185 and earnings from \$307,147 to \$513,159. Deliveries of the USAF rescue helicopter, the EH-199 Hinoke, will accelerate in the next six months.

• **Rothman Co.** sales in 1977 will approach half a billion dollars, \$100 million more than 1976, Rothman President Charles F. Adams reported. Backlog amounts to about \$450 million.

• **Garrett Corp.** reported its working capital position in the first year ended June 30, which also included increases in sales and earnings. Sales were \$193,641,545, compared with \$170,109,568. Earnings of \$4,707,796, which compared with \$4,135,707, a year earlier, represented a 2.45% profit margin on sales and a 19% margin on net worth. Current backlog at \$114 million, compared with \$118 million a year ago in 1976. The working capital increase, from \$25,052,277 to \$35,104,681 was obtained through sale of \$10 million in convertible debentures last year, \$9 million of which was used to reduce the company's V-Line borrowings. Problems in debt management reporting accurately in the industry are alleviated by the Garrett borrowings. After the debentures were used to reduce the V-Line to \$27 million in September, 1976, the company was required to increase borrowings against this line of credit to \$30 million by April to carry larger receivable balances. By June, these loans had again been reduced to \$27 million with a credit commitment of \$15 million available. But Garrett's receivable account rose from \$18,946,485 to \$28,576,613.

• **Atlantic Research Corp.** has purchased Jentis & Baker, Inc., 30-year-old communications research firm currently grossing \$1.5 million annually, and has acquired a 34% stock interest in Central Communications Co. in the Washington.



A BIG STEP AHEAD

Pratt & Whitney Aircraft's new turbofan engine—the JT3D-1—delivers 40% more thrust than the latest JT3D-3 turbojet engine.



This new engine handles 149% more air than the JT3D-3, although basic design structure and components are essentially unchanged. Dry thrust thrust increases from 12,000 lbs. for the JT3D-3 to 17,000 lbs. for the turbofan. American Airlines has announced its fleet of Boeing 707s will be converted to use turbofan. B-1B will use it in lieu of the Boeing Douglas DC-8s on order.

POWER IS THE KEY!

The key to flight advancements is dependable power. And dependable power is Pratt & Whitney Aircraft's business.

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... who have demonstrated a level of ability above mere competence... who seek assignments above and beyond their present capabilities... will find the technical challenge they desire in projects emerging from the Convair 880 and 600 Jetliners to the application of nuclear energy to weapons systems at Convair-San Diego. Significant work is in progress on electronic techniques for infra-red, radar and optical system reconnaissance, manned satellite vehicles, VTOL and STOL aircraft, anti-submarine missiles and detection systems, and anti-satellite studies.

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Titanium Bands Prevent Crack Propagation on DC-8

Titanium alloy (Ti-6Al-4V) bands are riveted at 15 in. intervals about the forward fuselage of the Douglas DC-8 to prevent crack propagation. The rivets are about 1,000 in. of titanium sheet, or the "up stopper" bands and on the engine and access panels. Unalloyed aluminum (6051A) is used for the access panels which are reinforced 2,000 transverse in. sheet panels.

Vibration Isolator

Support system for vibration isolation for guns and other equipment equipped with shock absorbers for one-directional vibration motion, but maintain high stiffness constant speed rotation.

The mount assembly utilizes metal Colapsed springs to maintain the desired stiffness characteristics. System damping is provided by elastomeric support.



ported vent dampers. Two configurations of the mount are in production and are incorporated in an aircraft wing gun and landing system. One model has an angular returnability of 10 sec. of arc.

Allied Research Associates, Inc., 45 Lomb St., Boston 15, Mass.



Portable Hoist

Hoist, capable of being operated electrically or manually, weighs 47 lb. and has a lifting capacity of 3,000 lb. The unit is operable for portable ground handling or airborne use, according to the designer.

Hoist's anti-falling mechanism, consisting of a spring shroud drive rotating the drive, prevents cable fraying and backlash. Power for the hoist is provided by a 3 phase, 480 cps, reversible a.c. motor contained within the cable drum. A modified version is supplied with a 24 v.d.c. or 60 cps a.c. motor. A desired function, giving it an increase, eliminating the danger of

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Boards Filter Division, 494 W. 12 Mile Rd., Madison Heights, Mich.

Non-Magnetic Space Battery

Schweiss battery, power two transmitters, a receiver, a magnetometer and other equipment in the Vanguard III earth satellite.

The 12B-65 Schottel battery, weigh-



ing 3.5 lb., delivers 15 amp. at peak pulse discharge. Expected life of the battery is approximately 90 days.
Vandier Electric Corp., 40-30 Locust St., New York, N.Y.

WHAT'S NEW

Publications Received:

The Big X-by-Black Book: Harper & Brothers, 49 E. 53rd Street, New York 16, N.Y. \$3.50, 240 pp. Novel about the professional and personal life of a test pilot.

Target for Tomorrow—by Dr. J. M. Lovitt. Fleet Publishing Corp., 70 E. 45 Street, New York 17, N.Y. \$4.95, 515 pp. A book on space travel based on scientific fact. Analysis is made on the use of satellites, space stations, space ships, etc.

Price of Used Commercial Aircraft 1959-1965—The Transportation Center, Northbrook, Illinois, Evanston, Illinois. \$10.00, 111 pp. A research report at a new year state of the price of used commercial aircraft which will be displaced at the surface of the world; rather the transition to advanced aircraft.

Basics of Micro Guide and Space Technology—Marion Helms, John F. Rider Publishers, Inc., 146 W. 14th Street, New York 13, N.Y. Through the use of pictures the author tries to make the most complex subjects understandable. Vol. 1 covers the principles of control and guidance. Vol. 2 the satellite design and position, characteristics and space capabilities in optics and electronics. Total of 504 pp. at \$5.95 per paperback, and \$9.00 for the two in single cloth binding.

Squadron Statistics-RFC, RNAS & RAF 1962-1963—Peter Lyons. Putnam & Company, Ltd., 42 Great Russell St., London, W.C1. No. 14,201, 268 pp. Details of operational squadrons and details of its components, aircraft types and strengths, most personnel subject to events and outstanding pilots. A complete and accurate chart of the RAF fighter squadron markings is also included.

Sounding Rockets—Herman E. Newell, Jr. McGraw-Hill Book Co., Inc., 510 W. 42 Street, New York 36, N.Y. \$12.50, 514 pp. Book on rocket design, high altitude research results, individual rocket detail and launching procedures. The principal operational launching methods of the U.S., England, France and Japan are covered.

Distorted Guide to U.S. Missiles & Rockets—Stanley Ufford. Doubleday & Co., Inc., 375 Madison Avenue, New York 17, N.Y. \$5.95, 125 pp. Descriptions of more than 45 types of U.S. missiles and rockets.



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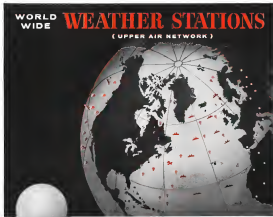
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These weather items prepared in consultation with the United States Weather Bureau



Upper Air Weather Stations dot the world. Observe techniques in all nations report upper air readings in accordance with international standards and recommended procedures.

OPERATIONS in accordance with plans developed by the World Meteorological Organization (WMO) and the International Civil Aviation Organization (ICAO), a vast network of weather stations, generally about 300 miles apart, takes upper air measurements 2 to 4 times daily. Through international cooperation, the results of these measurements are exchanged on a world-wide basis and are made available to the aviation field and the general public.

Upper air soundings are made with balloons carrying radiosondes which re-

port temperature, pressure and humidity at various levels. When available, special equipment also permits measurement of the upper winds at the same time. The combination of information allows meteorologists to analyze the complex structure of jet streams, detect temperature inversions,

etc. Mobil facilities are another world-wide service available to flyers. You'll find Mobil fuel, lubricants and service are available at key airports in the U.S.A. and overseas. Fly weather wise. Fly Mobil. You're always miles ahead!

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Each upper air sounding requires carefully calibrated instruments. Large balloons carry the instrument at 10,000 feet to 100,000 feet. Radio signals sent back inform you on temperature, barometric pressure and wind direction and velocity.



Four two thousand lbs. M45 drops from Boeing B-17 bomber ship 30,000 ft. over Edwards AFB at 215 H. 145. White seen at top and bottom of the red barage is fuel from liquid oxygen.

X-15 Exceeds Expectations on First Rocket Flight

Good Reaction Motors XLR-11 motor engines produced 10,150 g's acceleration that outlasted on the first powered flight at the North American X-15 (NW Sept 21, p. 10), pushing the aircraft toward the planned Mach 2 speed and 50,000 ft. alt. tests limits. At right X-15 begins climb with all eight thrust chambers firing. The low, after launch, the aircraft approaches Rogers Dry Lake for landing with vapor from rocket engines provide trailing behind. Bottom half of vertical stabilizer was parachute-retracted after jettison on load approach at about 1,500 ft. Aerobically, carrying full fuel load and weighing about 35,000 lb., flew into power for about 5.5 min.





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Soon you'll be seeing it — that Bell "De-all" of ship and shore, the HUL, packing a brand-new Allison power plant. This furred helicopter, distinguished performer in the Arctic and Antarctic, will be carrying 220 turbo-shaft horsepower, cruising at 100 knots, ranging over 200 miles with a payload of 3000 pounds and pilot. With these advances, plus its hover ceiling of 15,000 feet, its 1340 feet-a-minute maximum rate of climb, the newly designated HUL-2 will be a superior helicopter in every respect. Look for the Bell HUL-2, in such missions as patrol and rescue, IGV, ice breaking, and general utility work, to beat all comers in the light helicopter field.

The HUL-2 turbo-shaft engine is one of the latest to match a new development in use of several low-altitude and previously to yield needed economy of operation. In addition, most of the HUL-2 engine's advantages will be realized with the HUL-2 and HUL-3 series — making possible such production and early delivery in the field of a light, turbine-powered helicopter for touring and utility missions.

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Plastics Gain in Solid Rocket Uses

By Michael Yaffe

Atlantic City, N. J.—Development in plastic technology promises improved performance in solid propellant rockets and significant weight reduction in airborne components of both aircraft and missiles.

At the 134th annual meeting of the American Chemical Society here, chemists and engineers described their efforts in developing plastic rocket nozzles, plastic heat exchangers for rocket engines, new polyethylene solid fuels, and lighter conducting systems for airborne electronic equipment.

F. V. Fox of Westinghouse told how the use of small, hollow, phenolic spheres reduces the weight of a barrel embedded electronic circuit by 27%. Use of polyethylene fuel, he said, will cut the engine weight by 51%. But polyethylene's low thermal conductivity has restricted its use so far, in embedding transmission circuits where very little heat is generated. Fox insists combining tubes and nozzles, heat sinks would have to be designed into the package to take care of the heat these components generate.

Manufacturers of airborne electronic equipment have long been using plastic envelopes to protect their products against vibration, thermal shock, humidity, fungus and salt spray. The most popular formulation has been an epoxy resin with a silica filler to improve the resin's electrical and physical characteristics. The large amount of silica filler and, however, made the material too brittle when heavy for airborne applications. When various kinds of small hollow spheres appeared on the market, the aviation manufacturers were quick to investigate them as possible substitutes for the silica.

Originally developed to cut expensive losses on oil storage tanks, these spheres or microballoons had the lowest bulk density of any material available at the time. Westinghouse investigated three different kinds of microballoons, decided that the phenolic spheres were best on a weight basis. Thermal conductivity of the epoxy resin phenolic microballoons filler conducting system was poorer than that of the epoxy silica combination but not prohibitively so. Moreover, this particular combination showed the least stress under, and least resistance, for the filler to flow off all the low density filler completely embedded.

Phenolic plastics also showed up very well in Arquet-Graetz's investigations of materials for light weight, uncooled, solid propellant rocket nozzles. These tests, which are still going on, indicate, according to Arquet's George Epstein

and Harry King, that glass fiber-reinforced phenolic resin can be successfully used as nozzles at the design temperatures under conditions of chemical changes due to oxidation.

To test propellant materials under realistic conditions, Arquet researchers developed the SPAM (Structural Plastic Active Rocket) motor which operates on gaseous hydrogen and gaseous oxygen and is designed for firing at controlled altitudes (temperatures from 2,000 to 3,000° F). Small test nozzles are fit directly into the aft end of the motor.

Resins Used

Arquet used commercially available resins for the nozzles. Principal plastics used were heat-resistant phenolic, phenolic silicate and epoxy resin epoxy resin reinforced with chopped Kevlar fibers. It also included by H. Thompson Fiber Glass Co. which contains 96.97% SiO₂ and a melamine-glass fabric laminate. As part of the overall program, Arquet also evaluated different reinforcements, fillers and processing coatings. Some important results of these tests, as noted by Epstein and King, are as follows:

- **Heat-resistant phenolic** and phenolic silicate resins are essentially equivalent in performance and both are adaptable to exposure to the oxidizers and space vacuum tested.
- **Kevlar**, which attained a comparatively high amount of carbonization or charred condition, proved to be the best reinforcing agent, with Kevlar, "E" glass, glass, glass, stainless steel, carbon, phenolic, brass brass and nylon following in order.
- **Silica** life appears to be inversely re-

lated to the thermal conductivity of the reinforcing agent. The better the forcing agent, it is believed, flows a protective surface layer which puts in a heat-shielding thermal barrier.

• **Phenolic reinforcements** on more porous, finer meshwork fibrous materials.

- **Fibrous fillers** are preferable to non-fibrous fillers, probably owing to their adhesion in reinforcing the mechanical strength of the structure.
- **Reinforcements** laminated parallel to the gas flow tend to fail because of interlaminar stresses and successive peeling of reinforcement layers. Edge-glass reinforcements, which permit greater decomposition products to escape easily, made without changing structural integrity, are more desirable.

• **Thin, sprayed, insulating coatings** in vertical flow were detrimental to plastic nozzle performance. It was postulated that the heat conducted through the coatings caused the plastic to decompose with the generation of gases at the plastic-reinforcing interface. Because the gases could not escape through the relatively non-porous coating, the pressure built up to a point where it ruptured the coating.

One letter questioned Epstein and King's optimistic outlook on the use of plastic nozzles on the basis that the tests were run with a gaseous propellant and would not be valid for a solid propellant rocket which would throw solid particles into the exhaust. Arquet, the letter said, had tried it with solid particles in the exhaust and had found that the situation is in fact quite different.

Another letter disagreed with the authors' low rating for the phenolic-silicate-reinforced silica fiber nozzle. Results of work at General Electric indi-



Aluminum Trailer Carries Liquefied Gases

Up to 5,000 gal. of liquid oxygen or liquid nitrogen can be stored in stock in this aluminum trailer. Constructed like a Deere tank, trailer consists of two aluminum shells, separated by a vacuum space filled with an expanded silica insulator. Evaporation loss is said to be 0.1% per day. Design and construction of its trailers was a joint project of Booth Aircraft Corp. and Kewanee Aluminum & Chemical Corp. for the National Chemical Gas Division of Chemetron Corp.

the better performance for the visco-plastic type.

Epstein, who delivered the report noted that more definitive work was now under way, at Wright and among other things, that the SPAR motor will be modified to permit the injection of solid particles into the exhaust stream.

Clutch, related to the use of plastics in rocket motors is the use of plastics as heat conductors in solid propellant rocket motors, which was discussed by Walter Hout of Atlantic Research Corp. While plastics at first glance may appear to be the least promising candidates for a job where temperatures vary from 3,000 to 5,000° and pressures sometimes exceed 100 atmospheres, Hout said, they are actually well suited to the task because of their ability to resist catastrophic degradation and ablate uniformly at rocket motor temperatures. This property, the rocket engineers to resolve his problem by allowing controlled degradation of the insulating material without actual burning of the insulation wall.

Not all plastics are good insulators. The newer, Hout said, has a unique combination of properties which make reinforced plastics possess heat sink properties and which make an even significant one question that will haven't been answered completely. Enough results are now available to

provide a basis for predicting the essential properties of plastic heat insulations. Among them are:

- Plastic must form a continuous or rather stable residue.
- Char should be hard and strong to avoid erosion due to shear stresses and should be porous to allow transportation of the cool products of substrate decomposition.
- Char should form a framework for degradation of carbon from "coking" reactions and it should stay attached to the substrate materials.
- Char should be amorphous rather than crystalline, in order to provide maximum thermal conductivity.

High yield, reinforcing plastics Hout said are usually highly cross-linked thermoset resins. Some examples are the phenolic, epoxy-epichlorohydrin, and polyacrylonitrile systems. On the other hand, elastomers, urea-formaldehyde and the thermoplastic resins are generally low yield, clear formers.

When Marbach and Arnold Adcock of the Naval Ordnance Test Station reported on their group's search for better solid propellant polyethylene elastomers with good mechanical properties, particularly, tensile strength and elongation. While this work is not yet finished the NOTS scientists have found a promising polyethylene pre-

polymer which contains little or no attention.

At present, propellant experts are able to prepare polyethylene polymers with good low temperature mechanical properties (usually, tensile strength and elongation) from a dicarboxylic and polypropylene glycol that contains polypropylene glycol rather than a small but significant amount of terminal unsaturation, according to Adcock.

The saturated molecules act as chain stoppers in the reaction to form a long polyethylene polymer or chain, accounting for the use of large amounts of crosslinking agents to obtain a resin with good mechanical properties. They are also susceptible to oxidative degradation, and this may contribute to poor storage stability.

To solve this problem, NOTS has concentrated on the synthesis and characterization of new, liquid polymeric materials that could be used in place of polypropylene glycol. The group eventually investigated the copolymerization of ethylene oxide and tetrahydrofuran catalyzed by boron trifluoride with ethylene glycol as the "co-catalyst" and from this obtained their promising prepolymer. The other part of the project at NOTS is preparation of solid polyurethanes by reacting the new and other commercially available prepolymers with diisocyanates.



CCW-3 AIRCRAFT demonstrated by Carter Channel Wing Corp. is a Bonanza Regular fitted with channel wings

Channel Wing Flown in Demonstration

Washington—New plans for military and commercial application of the Carter channel wing CCW-3 aircraft were unveiled here last week by its designer, Wilbur R. Carter.

Following a demonstration flight of the CCW-3, Carter said the commercial channel wing aircraft will be built in Canada and Florida within eight months.

An Finner's Air Research and Development Company is scheduled to begin its evaluation of the aircraft within the next three to four months.

Wilbur R. Carter, president of Carter Channel Wing of Canada, Ltd., said records that his firm is establishing a production line at Guelph, Ontario, near Montreal and plans to produce 40 of the CCW-3 channel wing aircraft within the next year. According to Spence, 120 first order have been received by his company, with an average deposit of \$5,000 for the \$15,000 aircraft. Spence said that funds available to the designers from a variety of Canadian investors total \$2 million.

Plans to use the channel wing in Florida are being made by American Aerospace Corp., of Miami, which specializes in aircraft and engine overhaul and modification. The first conversion to channel wing design is the Bonanza. Flight demonstration of the conversion is planned for next spring, according to Charles E. Lewis, a member of the board of American Aerospace.

Lewis estimates that the channel wing will increase the C-45 cruise speed by 15 to 30%, the range by 5 to 12% and the payload by at least 15%.

One model of the CCW-3 will be built in Canada as flying and test demon-

strated earlier this month to representatives of the three military services at the Marine Corps Base at Quantico, Va.

This converted four-tailoff and landing aircraft is essentially a five-place Bonanza Regular with channel wings added.

During the demonstration at Quantico, it showed its ability to climb out of a field at an angle of more than 10 deg after a ground roll of less than 200 ft and at about 910° of its 5,000 lb gross weight. Full stops were accom-

plished within the same distance as landings.

The flights were made with a strong wind coming in at 40 deg. In the new way, and it was apparent that considerable pilot skill is required to make maximum performance flights. The nose has to be rotated upward at precisely the right moment on the high velocity air stream passing through the channel wing location off the ground and avoid the bottom of the tail, forcing it up and the nose back down. If proper control is made, the horizontal



COMMERCIAL production of the CCW-3 will begin in Canada, according to Carter

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tail can get under the wash from the channel and will be held down.

The company pilot climbed one mile alt. during the demonstration, apparently because he had waited too long to make the rotation.

Delivered at the CCW 5 to ARDC is scheduled to be made within the next 60 days after Center has made a final go/no-go decision.

Upon delivery to ARDC, the aircraft will be maintained by the National Aeronautics and Space Administration. Flight testing, probably will be conducted at a civil field at Dayton, Ohio. Results of the ARDC investigation will be made available to all those military services.

The channel wing idea augmented with Willard Center over 20 years ago, interest in the channel wing has been sporadic, and there have been sharp differences of opinion among structural engineers as to its value. In 1953, the National Advisory Committee for Aeronautics evaluated a Paper C-10 which Center had filed with channel wings (AV June 15, 1953, p. 23).

PRODUCTION BRIEFING

Hamilton Standard Division of United Aircraft, Windsor Locks, Conn., will develop and produce the temperature control system for the Canadian ACP attack fighter and the North American F-105 jet utility transport. Temperature control system for the F-105 regulates temperature in the cabin, electronic compartment, water separator for deicing, windshield deicing and pilot's seat, while the F-105 requires only cabin temperature regulation.

Nuclear Products-Elec Division, UCP Industries, Inc., Beverly, MA, will produce two additional flight instruments for the Republic F-105D fighter-bomber under N-4 million USAF contract. The instruments will include the F-105D's complete engine equipment, including the integrated instrument engine indicator, bombing and fire control and flight control systems.

Atre Metals Corp., Hawthorne, N. J., will start the fabrication of foil-riding reflector switch into space vehicle components under \$100,000 contract from the National Aeronautics and Space Administration. Metals to be studied under the contract include molybdenum, tungsten, columbium, titanium and hafnium.

North American Aviation has awarded B-70 and F-106 tool design and fabrication contracts totaling \$8.5 million to Aircraft Tool and Die Corp., Aircraft Engineering and Manu-

facturing Co., Basic Tool Industries, Inc., BSW Manufacturing Co., Production Service Co. and Tool Research Co. North American Aviation will subcontract approximately half of the tooling effort in the B-70 and F-106 programs.

Radioplane Division of Northrup Corp. will supply the pneumatic cargo and tactical kit packs for the Convair F-106A all-weather interceptor. Initial order is for 134 packs, consisting of oxygen generators, flame cloth and one pilot survival kit.

Swensen Gensowice Co., Santa Monica, Calif., has received follow-on orders totaling over \$725,000 from Beech Aircraft Corp. for flight control systems and parts for the Navajo KOD-1 light aircraft. The target is used for instruction and air force recruit training.

Parvex Co., Buffalo, N. Y., a subsidiary of Air Equipment Corp., will develop and produce the liquid oxygen handling system for both the North American B-70 Mach 3 bomber and the F-105 interceptor. Contract includes development of a liquid oxygen converter system, pilot's personal breathing equipment, supporting ground oxygen equipment and oxygen preservation.

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PIAGGIO P.116 has a range of 1,175 stat. mi., with 50 min. fuel reserve. Cruising speed close to 200 mph. Gross weight is 8,100 lb.

Aviation Week Pilot Report:

Piaggio P.116 Twin Shows Good Stability

By Robert J. Stenfild

Finke Lake, Ind.—Piaggio's P.116 is in right place two-engine executive transport, almost identical in appearance to the company's P.116 Royal Gull amphibian from which it was derived, is roomy, comfortable and stable—a good instrument airplane in the 100-mph, long-range cruise category.

Built in the Finke Lake plant of Piaggio & Co. Società per Azioni, Corsica, the P.116—the prototype of which was first flown in September, 1957—is assembled to U.S. standards

with U.S. components and marketed in the United States by the Tanager Aircraft Corp., Milwaukee, Wis.

Cost of equipped airplane in the United States approximately \$114,500. The Tanager price for the basic airplane starts at \$104,000 for the seaplane model and runs to \$107,500 for the 10-place (high-density) version. Costs of basic aircraft do not include engine, paint, interior appliances and rest, toilet and lavatory.

The engine incorporates the same gull wing, horizontal tail, and gear and propeller powerplant installations of the

P.116 Royal Gull amphibian, also marketed by Tanager and first evaluated by AVIATION WEEK two years ago (AW Sept. 10, 1957, p. 121).

Engines are two supercharged, horizontally opposed, six-cylinder Lycoming GSO-430 HICs, each developing 140 hp each at 3,400 rpm at sea level. Propeller has two three-bladed, metal, constant-speed Hartzell with diameter of 95.6 in. For European sales Piaggio offers its own propeller.

P.116 Characteristics

Features endorsed by AVIATION WEEK during a flight evaluation at Piaggio's Villanova d'Albenga airport include:

- **Takeoff and climb.** Cruising about 7,040 lb. and with a 40-deg. climb rate of 5 ft. with outside air temperature 25C, the P.116—with 25 deg. flaps lowered and brakes held until throttles were fully advanced—was pulled off after a roll of but 600 ft. Rate of climb averaged 1,200 ftm up to 10,000 ft. Engines deliver maximum continuous power of 120 hp each at 3,500 rpm which holds constant up to 10,800 ft. altitude.

- **Comfort and noise level.** The P.116 is comfortable and noisy, both from the standpoint of pilot and passenger. Its accommodations include lavatory and galley. Cabin, large for this class of airplane, has a width of 5 ft. 10 in., a height of 5 ft. 9 in. Volume is 100.2

BUSINESS FLYING

cu. ft. Volume during climb and cruise is at a maximum and, with power engines loaded high and to the max, the airplane is relatively quiet.

- **Cruise speeds.** At 8,000 ft., outside air temperature 5C, the P.116 indicated 165 mph, with engines having 2,600 rpm at 35 in. manifold pressure. True speed was 191 mph. At 12 in. and 2,800 rpm, the airplane indicated 174 mph for a true speed of 185 mph. Rotating propellers at 2,800 rpm, air speed indicated 155 mph (177 mph TAS). Specifications call for maximum speed of 226 mph, at 15,000 ft. and a cruise speed with 70% N1P10 (continuous except bleed-off power) of 200 mph, at 12,000 ft.

- **Stalls and engine range.** At 8,000 ft., pulling 12 in., the airplane stalled "clean" at 70 mph and "dirty" (gear and full flap) at 60 mph indicated. Stall characteristics are flexible, with light buffet and Safe Flight light warning preceding the "break." With the left engine feathered, right engine at 42.5 in. and 3,200 rpm, the airplane indicated 135 mph. Right aileron up, aileron holds directional control. Lateral control was good during banks.

The P.116 is an attractive looking airplane, not unlike an amphibian in appearance. In addition to its executive transport capabilities it may be used as an all-terrain ambulance or aerial water airplane. The short stage, flexible service, with two exits each installed in the cabin compartment (at 75.7 in. ft. volume), the seating can be increased to 9-10 seats.

The demonstrator flown by AVIATION WEEK, first prototype, owned by Piaggio, was taildragger L1244. Controls were both covered the bridle, sides of the wings and horizontal and vertical stabilizers. Engines are installed on the rear section of nacelles placed on the top surface of each wing, and are mounted on rubber bearings aimed at absorbing vibration.

Fuel is supplied from four rubber and, blades-type cells, one placed in the central section of each wing, between oil reservoir and main fuel pump and the other placed on the spindle-shaped nacelle at the wing tip. Refueling is via separate filler caps located on top of each tank.

Each wing tip tank has a capacity of 59.5 gal., each main fuel tank has a 16.5 gal. capacity. Total fuel—212 gal.—allows a range of 1,175 mi. at 15,000 ft., with 40 min. reserve, at 50% N1P10 power.

Side flaps, fitted by two outer and



INTERIOR VIEW of the P.116 cockpit points up aircraft's similarity to the amphibious P.116, from which it was derived. Structure is semi-monocoque without longnose aluminum control, both control light alloy ribs in each longitudinal.



COCKPIT of the P.116 with control yokes (feathered) between pilot's seats. Right-hand control column is easily movable. Gull wing (feeler) is built at two sections and folded to the feather. Without aids to efficient stall characteristics.



P.116 incorporates the same gull wing, horizontal tail, landing gear and propeller powerplant installations of the P.116 Royal Gull amphibian.

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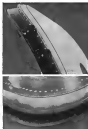
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INTERIOR of the P-166 looking toward cockpit. Note window, pilot's door outside.



AIRPLANE'S larger compartment is of 61.6 cu. ft. capacity, takes 300 lb. of cargo.

Two main parts, can be extended in increments down to 45 deg. maximum. They are in 19.6 sq. ft. With the aircraft fully loaded, full flap will lower power-off stalling speed about 10 mph. Maximum airspeed for full extension is 130 mph. Between 115-130 mph, it extends to 20 deg. in 10 seconds.

Positive gear is hydraulic, operated. When retracted the nose wheel breaks the linkage between struts, pivoting down about 4 in. With the main wheels retracted, only the linkage wheels are closed by jacking down. Wheel struts are visible, the wheels being raised by jacking down on the wing root bottom.

Passenger entrance to the tailfin-fitted P-166 is via left side entry door, ahead of the wing leading edge. The door is 26 in. wide x 55 in. high. The pilot's door, located on the right side, forward, is 25 in. wide x 42 in. high. It can also be used as a passenger emergency exit.

Two collapsible drains—connected when collapsed—are installed in the passenger compartment, one in the first leg right side and the other on the

passenger door. Oxygen outlets, lighting, ventilation and heating points are provided for each passenger.

All of the unobstructed passenger compartment is the feature, at 50-cu-ft volume. Part of this area is given around all four in a buffer. Behind the lavatory is a classroom for front cargo seats of 25 cu. ft. The rear cargo compartment, only reached when the airplane is on the ground, is of 61.6 cu. ft. capacity and takes 300 lb. of baggage. It is accessible through a door 15 in. high by 28 in. wide, aft of the cabin door.

The cockpit floor sits on a lighter load than the passenger floor. Large, multi-ported and dual side windows afford good visibility. Pilot's seats can be adjusted fore and aft, have also regulate seat back tilt. Controls are dual, with the right-hand column only movable.

The control pedestal, located between the pilot's seats, contains engine control levers, gear flap controls, friction lock, and manually operated control wheels for radio, electric and alternate static drive in optional and not included in the basic structure.

Flight instruments are located to the left and right, and engine instruments overhead, on the main panel. Equipment in the dashboard includes: Safe flight speed indicator, 12-channel

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center of gravity for two axes of the nose cone. Then, by rotating the cone 90°, another reading is obtained in the same manner along the third axis. Measurements are independent of gravity variations since the instrument operates on the principle of gravity moment balance rather than spring deflection.

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power, 11,800 ft. 128 mph
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power, 12,800 ft.) 266 mph
Cruise speed (50% MEKO
power, 11,800 ft.) 185 mph
Roll speed, flaps and gear down 61 mph
Roll speed climb 31 mph
Rate of climb, sea level, two
engines 1,305 fpm
Rate of climb, sea level, one en-
gine inoperative 363 fpm
Service ceiling, two engines 27,000 ft.
Service ceiling, one engine inop-
erative 15,800 ft.
Takeoff distance (over 10 ft. ab-
solute) 1,590 ft.
Landing distance (over 50 ft. ab-
solute) 1,312 ft.
Range, 10,000 miles, 19,800
ft., 50% MEKO power (no
flaps) 1,249 mi.
Range, 10,000 miles, 19,800
ft., 50% MEKO power (flaps
down) 791 mi.
*Based on a gross weight of 7,516 lb.
and standard atmosphere conditions.
Alternate gross weight is 5,190 lb.

which is 8 deg. steeper than the No. 1 to No. 5. From No. 5 to the wing tip, incidence decreases gradually, due to wing curving to attain 1 deg. at No. 15 ribs.

The airplane was quite docile during the stalls described earlier, it 70 mph "cleared" and fell 100 ft., the nose dropping straight ahead in each in-

stance. Recovery is rapid, the nose coming up with increase in speed. Lateral stability is good.

Angular travel of the P.166 control surfaces is as follows: ailerons, 24 deg. up, 19 deg. down; elevator, 18 deg. up, 14 deg. down; rudder, 27 deg. left and right. Elevator has tab travel 30 deg. upward and downward; rudder has tab travel 23 deg. left and right.

Single-Engine Performance

The left engine was feathered at 7,500 ft. and the right engine advanced to 42.5 in. and 2,200 rpm. At this power setting, the airplane, indicated 115 mph and directional control was held with ailerons. With 7 deg. of rudder trim installed, the P.166 flew straight and level in steady flight. The airplane was banked up to 45 deg., left and right control and stability remaining good. Demonstrator airspeed was reduced at 214 mph. From a normal descent, with left engine brought back in, two pilot engines quit, the wheel to demonstrate the ruggedness of the P.166.

Power on both engines was set to 18 in. manifold pressure and 2,100 rpm. At this setting the airplane was also trimmed down to stall. The airspeed read just below and indicated 710 mph. Rate of descent ranged to 5,000 fpm. Engines stalled briefly and pointed to both these instruments, following which a normal descent was initiated at 15 in. and 2,000 rpm. Speed fell off to 170 mph, rate of descent to 1,500 fpm.

Rectangular pattern speeds in the P.166 ran to 330 mph with 10 deg. of flaps on downstroke, 120 mph on base.

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Spraying Gear Designed for HU-12E

Crab spraying equipment for the Bell HU-12E has been developed by the Agricultural Aviation Engineering Co. (AAVENCO), which features lightweight bodies with 100 gal. tank capacity. Equipment is mounted on the one raised by use of quick release pins. Spray booms are foldable for over-the-road transport. Spray pumps, built by Polysol and Autonetics, in both drives from an engine driven power-takeoff arrangement. Present equipment is designed to be compatible with one boom type dry chemical equipment under develop-
ment at AAVENCO.



First Photo of Beech Four-Place Model 33

Highlight of Beech dealer and distributor's meeting in mid-November will be first showing of four place business plane in the "\$25,000 price category" aimed at providing the company's sales force with a product competitive with Piper's Comanche and Cessna's new 440 (AW July 5, p. 31). Also significant: The Model 33 will enable Beech to broaden its sales effort structure by making it possible for more dealers to make the acquisition due to the airplane's price, and lengthening comparison with other manufacturers. Primary external feature of the Beech 33 is the wing vertical tail, which distinguishes it from the Bonanza. Indications are that lower price (current standard Bonanza K33 lists at approximately \$25,500) of the Model 33 was attained by using a considerable amount of Model 35 tooling and by deleting many of the other airplane's more expensive features, such as photo extension and multi-color paint schemes. Powerplant is a 324-hp, Continental IO-470-B four-cylinder engine. Model 33 is scheduled to fly later this month; is expected to be certified in late November and delivery leads begin soon after the showing.

with appropriate flap extension, and 110 mph as final approach, with 40 deg. of flap best for power-on, short-field landing (75 deg. of flap for manual landing).

The short-field approach was used with engines turning 3,000 rpm. The airplane was indicating 90 mph over the fence and touched down about 75 mph. Full stop was made after a roll of about 700 ft.

All utilization elements of the airplane's electrical equipment are fed through a barrier by two 28v., 75 amp. hr. parallel connected, engine-driven generators and by two 12v., 11 amp. hr. fuel-line charge batteries connected in series and located over the nose gear wheel well. Both nose and main gear are provided with lock-down sensitive type Magneto shock absorbers and Goodrich shocks, tires and single-disc brakes. Emergency extension is through a hand hydraulic pump. Hydraulic system is composed of a

pressure feeding set which supplies landing gear, variable wheel steering, flap brakes, and wheel-brake unloading circuit. Cable connections are via two systems. The first provides (via a South West 25,000 lbs. booster), both on the ground and during flight, for modulation of temperature controlled heat or cold at which control is controlled in the master section. The second operates only in flight, feeds cold air through an hand-adjustable valve leading to pilots and passengers.

Sea-state oxygen station is optional. A 51 in. ft. high-pressure cylinder would be installed under the left hand wheel well structure. The aircraft's windshield wiper is electrically operated. Weather radio can be installed in the nose.

Via date Pugsley has had 12 firm orders for the P-165. Six of these have been from Trekco, to which three aircraft have been delivered. The remaining six orders are divided as follows:

one to Switzerland, one to New Guinea, two to Germany and two to England. Average European price of the basic (standard) airplane is about \$28,000. Price does not include radio, navigation and deicing equipment, autopilot, weather radio and engine equipment. It does include the fuselage and buffet.

Foreign marketing representatives, in addition to Trekco, include Australian Bristol Aviation and, in England, Aero Enterprises. Ltd. Pugsley's chief services Italy. Deliveries follow orders by two three-month intervals. Work was told. Four aircraft per month are produced at the Frosinone Ligano plant. The rate would jump with an increase in orders.

During the AVIATION WEEK visit aircraft numbers seen, right and wrong were on the line at the French Ligano plant. There have been orders in England, the U.S. (Trekco) and to New Guinea, respectively.

Deliveries to Milwaukee average 18-



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AC's new R & D Group is devoted to the Research and Development of advanced systems and components. Current programs include many vital projects: laser-photometry navigation and guidance; digital computer development; Advanced inertial sensors; Passive electronic detection, surveillance and navigation systems; Guidance systems for ballistic missiles, space vehicles and aircraft.

If you are a graduate in the electronics, math, physics, electrical or mechanical fields, or if you have an advanced degree, you may be able to participate in these programs. For more details, write the Director of Scientific and Professional Employment, Mr. Robert Altier, Oak Creek Plant, Box 746, South Milwaukee, Wisconsin.



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25 days on site. Aircraft are shipped complete to Trekler by sea, and painting, minor engine and propeller, wheels, tires and instruments. All fittings are ground for sea qualification and tested both in Italian and English (Pugliese also has a technician at the Trekler plant).

First delivery of a P 166 demonstrator to the United States was in December, 1975. Trekler's first sale was to Dilling Yacht, Inc., of Houston, Tex. (AW May 4, p. 167). The second is contracted for a Long Beach, Calif., owner.

Pugliese's Florida Lagoon plant has a total ton of 281,265 sq ft, of which 441,120 sq ft is covered. In addition to the P 166 and P 166-L amphibians, the company produces the P 145 jet army trainer, the P 110 advanced trainer, the P 110 D training helicopter which is being upgraded at West Germany, and contracts under license Licensing 100 hp and 200 hp piston engines.

Company also produces its own 41 series, constant speed, propellers for medium power engines including one model fitted with an elastic coupling and intended for installation on engines with no dampers, ranging up to 220 hp.

PRIVATE LINES

Production of Aresair II flying automobile is dependent upon receipt of deposit for \$1,000 covering 180 orders, the company, Wash., manufacturers reports. Plan is to put deposits in escrow, payable to Aresair on delivery, which could begin in October, 1980. If delivery dates are not met, deposit would be returned to customer with 4% interest. Power-plant plans for present of balance over 70 months. Guarantee of price, at the factory, is \$4,500. Aresair has been fully approved by Federal Aviation Agency.

Electronic Equipment Engineering, Inc., Dallas, Tex., acquired full control of Pan-Air Electronics Corp., Redwood, Calif. Both firms specialize in design, engineering and manufacturing of complete electronics packages for aircraft. BEE has current backlog at over \$600,000. Pan-Air has contracts for DC-8 from Douglas and B-747 for approximately \$2,500,000. Future firm contracts moved into new 3,000-sq-ft facility, four times larger than previous plant.

New York State Department of Commerce will purchase a low-price light twin to replace its single engine aircraft which was wrecked in an accident recently at Chateaufort Airport, N. Y. Type of aircraft the Department will acquire was not disclosed.

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Systems Engineering - Design of special facilities for storage and transfer of cryogenic liquids and the associated high-pressure gas. Responsibilities also include surveillance of test systems and collection testing of the system.

Qualifications Degree in engineering plus three years' experience. Applicants must be U. S. citizens. Some travel and possible relocation away from ADC's Langhams, Massachusetts, laboratories.

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For these openings, advanced engineering study and relevant military experience will be valuable. These are not purely advisory positions. Those men chosen will be expected to participate actively in the execution of Division Engineering Programs.

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Background of computer and system development for bombing, fire control, or navigation. Experience with analog and digital systems, test, weapon characteristics, and performance determinations.

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First-hand knowledge of design techniques for advanced circuits—dc, low frequency, pulse, and r.f.—for control, computation, measurement, and communication. Must be knowledgeable with respect to solid state devices and circuits and interested in making major contribution to Division application of modern circuit techniques.

To arrange an interview, write to:

J. H. Rogers, Chief Engineer,
Preliminary Development Staff, Dept. 582D

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